Archaeogeophysical Investigations of Early Caddo Settlement Patterning at the Crenshaw Site (3MI6)

Archaeogeophysical Investigations of Early Caddo Settlement Patterning at the Crenshaw Site (3MI6)

A thesis submitted in partial fulfillment
of the requirements for the degree of
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By

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Abstract

The Teran map, made during Don Domingo Teran de los Rios' expedition for New Spain, shows a Caddo settlement in 1691 with a vacant mound center and many small farmsteads dispersed across the countryside along both banks of the Red River. This map, combined with the 19th Century photographs taken by William Soule, provides a testable model for the settlement pattern of the Caddo people called the Teran-Soule model. This model states that large numbers of people besides a small caretaker population did not inhabit the mound centers, supporting a vacant mound center hypothesis. Recent studies have begun to challenge this hypothesis, using archaeogeophysical techniques to find structures near Middle to Late Caddo mounds.

An archaeogeophysical survey of the Crenshaw site along the Great Bend of the Red River was conducted to determine if structures could be found there. Is the settlement pattern at this early Caddo site, occupied between A.D. 700 and 1400, consistent with the late historic model of a vacant mound center? Is there evidence that both Caddo and Fourche Maline occupations existed in horizontally distinct components? The 3.2 hectare survey identified more than 100 possible structures, of which more than 50 are probably structures associated with the Fourche Maline or early Caddo occupations of the site. Several structures were found in linear patterns, including an oval series of possible structures measuring 90 x 85 m in diameter. While cultural affiliation was not determined for most of these features, some can be attributed to Caddo origin based on architectural attributes, such as extended entranceways. This suggests that Crenshaw was not literally vacant, but the presence of extended entranceways suggests that some of the identified features were special use structures, which does not conflict

with the vacant mound center hypothesis. However, the large number of possible structures present with unknown cultural affiliations provides ample opportunities for testing the model.

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Dedication

This thesis is dedicated to my wife, Jennifer Samuelsen, and daughter, Eva Samuelsen, for they are the only ones who could encourage me to finish. The birth of my daughter was the greatest impetus to get me to complete this work. Jennifer sacrificed to allow me to work so much while she was pregnant and taking care of Eva. I will be forever grateful and will always love them both.

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Chapter 1: Introduction

The Crenshaw Site and the Teran-Soule Model

The Crenshaw site (3MI6), located in the Red River Valley on the Great Bend of the Red River in southwest Arkansas, is currently thought to be one of the oldest Caddo ceremonial centers (Schambach 1996). Crenshaw had six mounds (A through F) at the time of Clarence B. Moore's (1912) test excavations of the site. Since then, Mounds B, C, and D have been excavated or destroyed and three large trenches were dug through Mound F. Mounds A and E are in relatively good shape, as is most of the western portion of the site, but their surfaces are pitted as a result of over 100 years of excavations and looting at the site. Excavations revealed that the site was occupied by both Caddo and "Pre-Caddo" peoples (Lemley 1936). Frank Schambach (1998) identified the aboriginal people who lived at the site prior to the Caddo occupation as belonging to the Woodland period Fourche Maline Culture (ca. 800 B.C. to A.D. 900), based on his work at the Cooper and Means sites in southwestern Arkansas, as well as for the range of Fourche Maline Culture artifacts and archaeological deposits found there.

The Teran map, made during Don Domingo Teran de los Rios' expedition for New Spain, reflects the interpretation of a Caddo settlement as observed in 1691 (Perttula 2005; Wedel 1978). The map depicts a mound at the western edge of the settlement with one building on top; the area around the mound was otherwise vacant of houses. Family households are shown dispersed farther down the Red River, away from the mound. William Soule of the Smithsonian Institution took two photographs of a Caddo farmstead in Binger, Oklahoma in 1869 and 1871, which provided more information about Caddo settlement patterns (Schambach 1982a). The Teran-Soule model, as defined by

Schambach (1982a), states that the Caddo had vacant ceremonial centers, which has recently been called into question at Middle and Late Caddo ceremonial centers both in the southwestern Arkansas uplands and lowlands (Lockhart 2007; McKinnon 2008). With the understanding that Crenshaw is an early Caddo ceremonial center with an earlier Fourche Maline component, the goal of this study is to contribute new evidence concerning the development of settlement patterning in the southern Caddo area by testing the Teran-Soule model at the Crenshaw site.

Spatial Context

Before the 1970's, the area between the Plains and the Lower Mississippi Alluvial Valley did not have a well established name. The Caddo area was defined using estimated Caddo boundaries that may not apply to earlier Archaic and Woodland occupations. Instead of using a cultural boundary, Frank Schambach used Braun's 1950 reconstruction of forest cover to determine alternative environmental boundaries for the region he referred to as the Trans-Mississippi South (Schambach 1971a, 1998).

The Trans-Mississippi South is defined as the biogeographic region between the Lower Mississippi Alluvial valley to the east and the Plains on the west (Figure 1.1). The northern boundary is made by the Missouri River which divides the northern prairie from the Ozark Plateau to the south. The southeastern boundary extends to the beginning of the swamp areas of the West Gulf Coastal Plain. The southwestern boundary stops at the Edwards Plateau. The Trans-Mississippi South is partially made up of oak and hickory forest in the northeast and includes the Ozark Plateau and the Ouachita mountains. Oak and pine forests cover the southeastern area which including southeastern Texas, southwestern Arkansas, and northeast Louisiana. Both of these areas have been dominated by those forest covers since the middle Neocene, but with pine appearing more recently (Braun 1950). The southwestern forest cover into eastern Oklahoma and Texas is a combination of oak forest, hickory forest, and prairie. Much of this prairie transition area in eastern Oklahoma was determined to be occupied by Plains people since the Archaic period and has since been taken out of the Trans-Mississippi South (Vehik 1994; Wyckoff 1994). Fauna, climate, and terrain were included as factors in the delineation of this region, but the most important aspect applied was forest cover (Schambach 1971a, 1998).

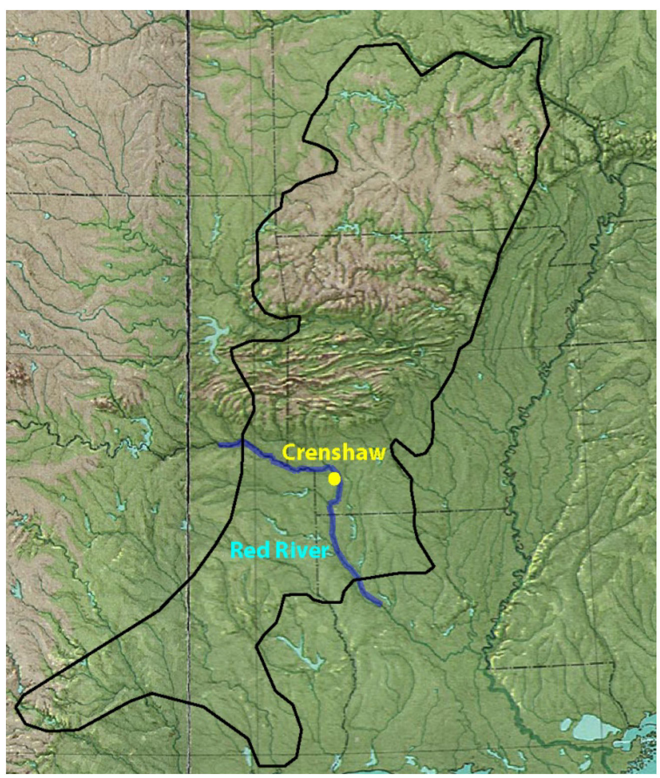

Figure 1.1 – Trans-Mississippi South (after Schambach 1998:Figure I-1).

As the Red River flows out of Oklahoma and Texas into Arkansas, the river forms the Great Bend changing directions from an easterly flow to a course to the south. Crenshaw is found here, centrally located in the Trans-Mississippi South. The Red River valley is flat and wide and, before modern intervention, constantly shifted channels due to the easily eroded soils. In the past, this fact imposed great havoc on the people in this area, producing among other things a large number of rafts that caused floods and blockages of the river. These floods caused European settlers to largely stay out of the area until 1833 when specially built snag boats began to move the trees and debris clogging the river. Once the river was cleared, settlers came into the land in greater numbers and began to realize the potential for agriculture in the rich soil of the Red River valley. In 1835 the United States government pressured Caddo leaders to sell their ancestral lands for 80,000 dollars and forced them to move to Texas (Smith 1994:125).

Cultural Context

Based on ethnohistoric records, the Caddo had many independent communities at the time of the first European contact. Caddo communities banded together by forming alliances with neighboring Caddo communities. Three major alliances played a large role in Caddo political organization during the contact period: the Hasinai of eastern Texas, the Nachitoches of northeastern Louisiana, and the Kadohadacho of southwest Arkansas where the Caddo get their name. While some other communities had power outside of these alliances, those three groups continued to develop power during their interactions with the French and Spanish expeditions (Smith 1994). Depopulation and consolidation are believed to have led other communities to join these alliances during the contact era (Early 2000; Perttula 1992).

Crenshaw's location along the Great Bend of the Red River puts it within the boundaries of the later Kadohadacho alliance. The Haley site offers a possible connection between Crenshaw and the Battle site (3LA1), as they each have possible Haley phase occupations (Hoffman 1970:172). Therefore, there may have been a short period of time when these two mound centers, approximately 23 km apart, coexisted. The presence of Late Caddo sites in the area, such as Battle, indicates a continuing presence after the abandonment of Crenshaw though to the time of the Kadohadacho alliance.

Excavations revealed that Fourche Maline people occupied Crenshaw before Caddo people with a possible transition between the two taking place at the site (Lemley 1936). This documentation of the transition from a Woodl1and-period Fourche Maline way of life to the Mississippi-period Caddo in the archaeological record provides the possibility of great discoveries about the transitions between these cultures and the formation of the Caddo. In fact, one period is called the Formative Caddo period (A.D. 800 to 1000), using Perttula's (1996:Table 1) chronological framework, as it encompasses the transition at Crenshaw and the better known and more heavily excavated George C. Davis site (41CE19).

Settlement Pattern

More than 700 Fourche Maline sites have been identified in southwest Arkansas, indicating a significant occupation of the area. Archaeological evidence indicates that the first occupations began sometime between 1000 and 500 B.C. and lasted until about A.D.

900 when the Caddo began to emerge. Small villages, sometimes occupied for long periods of time, were common and are distinguished by areas of dark midden (Schambach 1982b, 2001).

Two Fourche Maline structures used for special purposes have been excavated at the Bellevue mound and the Cicero Young mound (3LA7) (Fulton and Webb 1953:27; Schambach 1982b:146). However, the discovery of definite Fourche Maline houses used for domestic purposes has proven elusive (Schambach 2001:31). Possible Fourche Maline domestic structures have been identified at three sites. One rectangular structure measuring 8.5 m wide and 30 m long was found at the Poole site which had two Fourche Maline burials associated with the structure and abundant artifacts associated with a Fourche Maline occupation (Wood 1963a, 1981). Schambach (2001:31-32) questions the structure's association with the burials and casts doubt on the likelihood that the structure was built before the burials. Schambach (2001:32) also questions the likelihood that a structure at the Ray site in Lamar County, Texas was created by the Fourche Maline. While the site has a date indicating a late Fourche Maline occupation, the properties of the structure, he points out, are similar to Caddo houses at the George C. Davis site. Instead he points to two 15 m wide circular structures uncovered at the Martin site in southwest Arkansas as likely Fourche Maline houses. However, there is a possibility that they may be considered early Caddo rather than late Fourche Maline. This issue emphasizes the problem of studying a site that transitions from Fourche Maline to Caddo as it will cause problems for determining cultural affiliation without strong evidence, analysis, and confirmation. It may be underestimating the complexity of the transition from the Fourche Maline to the Caddo cultures to consider them discrete cultures during the Formative Caddo period (A.D. 800 to 1000) at some sites, such as Crenshaw, until more is known about the hypothesized transition. A Crenshaw phase (A.D. 700 to 900) Fourche Maline occupation at Crenshaw must be considered as a possible origin for any structures found at the site. This means that any conclusions about Caddo settlement pattern based on archaeogeophysical evidence will have to be groundtruthed in the future for confirmation. However, conclusions can be drawn if enough evidence is gathered to indicate common architecture and geophysical properties between sites and anomalies with similar cultural affiliations.

In contrast with the Fourche Maline, the settlement pattern of the Caddo is partially revealed through ethnohistoric accounts from European contact. Most of the ethnohistoric record was produced by Spanish explorers and missionaries in east Texas and consequently describes the Hasinai alliance (Early 2000:128). This creates a gap in the ethnohistoric record for the Caddo in other regions, including the Kadohadacho alliance in the Red River valley. While the time between the existence of the Kadohadacho alliance and Crenshaw's latest occupation is long, cultural attributes assigned to this alliance are more likely to be associated with Crenshaw than other historic alliances due to their presence in the same region. Early (2000:127) emphasizes that regional differences between the alliances will likely be discovered by continuing to gather information about the Caddo of different regions. This means regional differences in settlement patterning are possible and should be tested when enough information has been collected in each region.

One ethnohistoric record that has influenced our conception of Caddo settlement patterns is the record taken by Domingo Teran de Los Rios during his 1691 expedition through the Great Bend of the Red River (Wedel 1978). An anonymous drawing called the Teran map (Figure 1.2) was made showing an Upper Nasoni village largely on the south bank of the Red River (Early 2000; Mckinnon 2008; Perttula et al. 2008). It shows many farmsteads with one or two houses with the occasional storage platform and drying rack. The farmsteads are aligned with the river suggesting that they did not stray too far from the water source. Some of the farmsteads are surrounded by some kind of circular barrier or enclosure. It also shows a temple mound with a single structure on top which may have a floor slightly below the mound surface. Of particular importance to archaeologists, this document indicates a dispersed settlement pattern with small family farmsteads spread out over a large area. As mentioned previously, these farmsteads are associated with a vacant ceremonial center. The mound depicted on the Teran map has one building on top and perhaps an associated service facility, but the surrounding area is devoid of any structures.

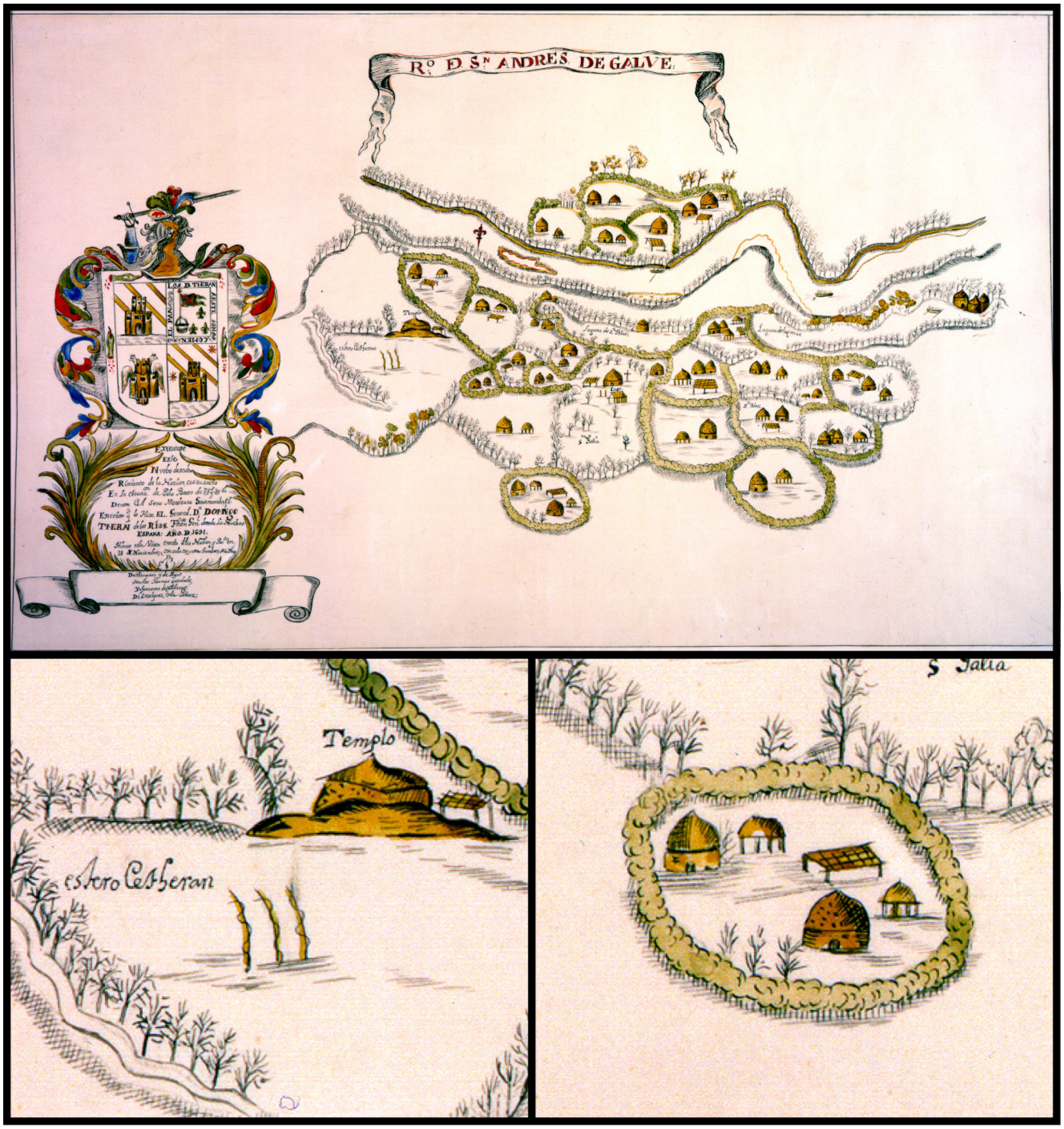

Figure 1.2 – The Teran map: top, Teran map; bottom left, vacant mound center shown with a mound and a temple on top; bottom right, small farmstead with several structures.

The Teran map is thought to represent the Hatchel-Mitchell-Moore site complex ten miles northwest of Texarkana (Lockhart 2007:8; McKinnon 2008:4; Perttula 2005:181; Perttula et al. 2008:93; Schambach et al. 1982:93; Wedel 1978:14). Perttula et al. (2008:93) suggest that the Hill Farm site (41BW169), southeast of the Hatchel temple mound, may be two of the compounds represented in the Teran map. The Hatchel-Mitchell-Moore site complex is located about 45 km from Crenshaw by river. This site is considered to be an Upper Nasoni or Kadohadacho village during that time (Early 2000:129).

Between 1868 and 1872, Smithsonian Institution's William S. Soule took two photographs that captured Chief Long Hat's farmstead containing more ethnohistoric information about Caddo settlement patterns. They show outdoor shelters, arbors, beehive-shaped storage platforms, and houses in groups which were located near Binger, Oklahoma (Schambach 1982c:7). These photographs seem to provide support for the farmsteads shown in the Teran map, containing similar structure types and groupings that are remarkably consistent given the 170 year gap between the documents and the large spatial distance between the locations where the accounts were recorded. Combined, the Teran map and the Soule photographs provide a Teran-Soule model describing the Caddo settlement pattern in the Great Bend region (Schambach 1982a:120-122).

Some details in the Teran map conflict with known attributes of Caddo sites. One obvious problem with the representation of structures in the Teran map is the lack of structures with extended entranceways, which are known to exist at many Caddo sites (Perttula 2009). The archaeogeophysical testing at the Hill Farm site revealed possible structures which may be represented in the Teran map, including two that may have an extended entranceway (Perttula et al. 2008:102). However, those possible structures may not have been present at the time the map was made and require groundtruthing to confirm their interpretations.

Archaeological evidence has revealed a more complex picture than the ethnohistoric accounts provide. Most communities are made up of single family farmsteads or small multiple family hamlets. Single family farmsteads commonly have one or two buildings and family cemeteries. The small multiple family hamlets may have a few buildings, family cemeteries, and refuse pits (Perttula 1996:310).

There were also larger communities such as Oak Hill Village (41RK214), occupied between A.D. 1150 and 1450, which had many structures and midden arranged around a plaza. The village consisted of overlapping structures, burials, and trash pits encircling a mostly clean plaza. In addition, some structures existed outside the circle while two burials were located on the outer edge of the plaza. The excavated portion of the village consists of 43 Caddo wooden structures with 156 features including pits, rock piles, and hearths (Perttula and Rodgers 2007; Rogers and Perttula 2004).

The Teran-Soule settlement model, as constructed by Schambach (1982a:120-122), hypothesizes that a Caddo settlement pattern consists of dispersed communities centered on a common vacant ceremonial center where important rituals for those communities would take place. Crenshaw is believed to be one of these ceremonial centers partially due to the commonality with other Caddo ceremonial centers of having multiple or large earthen mounds. The contents of the mounds confirmed this idea as multiple burials with large amounts of pottery and other associated artifacts were found. Many burnt or buried houses have been found on or under mounds at Caddo sites, providing support for the drawing of a single temple on the mound in the Teran map (Trubitt 2008). A *xinesi* would likely have occupied a building on or near the mound and had the responsibility, along with assistants, of maintaining the sacred temple fire (Early

2000). However, key to this settlement pattern model is the lack of significant habitation within the ceremonial center or the vacant mound center hypothesis. The discovery of a few houses may only indicate that a *xinesi* and his assistants lived near the mound for a long period of time. In order to discover if there was significant habitation at a site, it is necessary to test a site for the presence of midden, structures, and other evidence of habitation. In order to conclude that more people were living there than can be explained by a few individuals responsible for ceremonial activities at a site, a significant number of domestic structures must be found. They must also be shown to be relatively close in time and space. A good test of this hypothesis would include excavation and absolute dating techniques. One such example is archaeomagnetic dating which may, given a well calibrated polar curve, accurately date burnt material to within 20 to 25 years of a burning episode (Sabo 2009; Wolfman 1982). This is optimal for dating Caddo structures based on Good's (1982:69) estimate that Caddo houses at the Deshazo site (41NA27) lasted an average of 20 years. If that estimate applies well to structures at sites like Crenshaw, then archaeomagnetic dating may prove to be a valuable tool for determining if structures existed contemporaneously.

There are possible limitations for the Teran-Soule settlement model as it pertains to sites separated in time and space. The model may apply to one region, but may not apply in an adjacent region. Schambach's (1982a:120-122) description of the model was featured in a manuscript dedicated to the Great Bend region, but does not directly state that this model applies only to this region. Schambach (personal communication 2009) intended that the Teran-Soule model only be applied rigorously in the Great Bend region since the site represented in the Teran map was within this region. This restriction of the model allows for the existence of variants in other regions. Even within the same region, environmental conditions may cause variation in the settlement model, such as upland centers versus lowland centers (Lockhart 2007). The settlement pattern also might have changed over time, requiring testing for time depth within the same region.

Archaeogeophysical Research

One example of where the Teran-Soule model applicability is in question outside of the Great Bend region is the George C. Davis site in East Texas. Crenshaw is often compared to George C. Davis due to their proximity in time. Maps produced from the University of Texas (UT) and the Works Progress Administration (WPA) excavations conducted from 1939 to 1941 show many structures in groupings around Mound A. Some areas around the mound are less concentrated with structural remains than others, but the eastern side of Mound A contains evidence of many overlapping structures despite heavy plowing of the area (Newell and Krieger 1949; Story 1997). The fact that these structures are overlapping limits the likelihood that many of them were standing at the same time and probably indicates that the area was used over a long period of time. While describing the results from Mound B, Story (1997:65-67) suggests that the structures on or under the mound may be explained by the concept of an inner precinct, or a special area where community activity took place including habitation by people who may have performed political activities, ceremonies, or social activities.

Recent archaeogeophysical investigations at George C. Davis show another grouping of overlapping circular anomalies and suggest that areas with a high density of structural remains are not isolated to the area adjacent to Mound A (Creel et al. 2008;

Osburn et al. 2008). Creel et al. (2008) used a Geometrics G-858 cesium magnetometer to collect data on Mound B and a large area around the mound. The appearance of circular anomalies and a rectangular anomaly suggest that structures are present in the area around Mound B. However, some anomalies may be attributed to midden deposits or other cultural features. Osburn et al. (2008) also used a Geometrics G-858 cesium magnetometer to collect data, but concentrated their efforts on an area to the northeast of Mound A. The results showed a grouping of at least 10 possible structures and 4 partial circles within a 100 x 100 m area, some of which overlapped with the UT-WPA excavations. These structures are located far enough from Mound A to question if they are part of an inner precinct, but this is a subjective determination without excavation. As with all archaeogeophysical results, they could benefit from groundtruthing to support interpretations. An excavation of these possible structures could help determine if some of them were built for habitation rather than ceremonial use.

The other key distinction (besides region) between the George C. Davis site and the accounts from which the Teran-Soule model is based is that this Caddo ceremonial center was occupied during a different time period. The occupation at George C. Davis ended 200 to 300 years before the Teran map was made, with most of the occupations by the Fourche Maline and subsequent Caddo cultures taking place between A.D. 600 and 1400 based on radiocarbon dating (Story 1997). The time between the accounts and the site's occupation should be considered when making an ethnohistoric analogy. While more research needs to be done on the settlement pattern around the site, George C. Davis has enough evidence of structures to encourage testing for a domestic population.

Archaeogeophysical surveys are increasingly being used at Caddo ceremonial centers as well as habitation sites to answer questions about a range of issues (Walker and Perttula 2008). Some have shown promise in the ability to identify the presence of possible structures at Caddo ceremonial sites in southwest Arkansas (Lockhart 2007; McKinnon 2008). Jami Lockhart's (2007) archaeogeophysical survey at Tom Jones site (3HE40), a Middle Caddo site located in the southwest Arkansas uplands, used four archaeogeophysical technologies, magnetometry, electrical resistance, electrical conductivity, and magnetic susceptibility on six grids sized 20 x 20 m around Mound A. In these six grids, as many as seven structures were identified with archaeogeophysics some of which were confirmed through excavation led by Frank Schambach. The data suggests ceremonial structures were located near the mound, which does not contradict the vacant ceremonial center hypothesis, since the structures were likely used by a caretaker population. Duncan McKinnon (2008) also tested the Teran-Soule model at Battle Mound. Battle Mound is located in the same lowland region as Crenshaw along the Red River. However, Battle Mound is a Late Caddo settlement and, like Tom Jones, is later than Crenshaw. McKinnon completed a large scale archaeogeophysical survey of Battle Mound taking 7.7 hectares of gradiometry and discovered several possible structure clusters and other anomalies in the field around Battle Mound.

This study follows Frank Schambach's (1982c:7) suggestion of testing the Teran-Soule model for accuracy and time depth. The first steps in testing the Teran-Soule model would be to locate areas where midden and possible structures are present. At Crenshaw, some midden areas have already been identified and a single structure has been excavated. Schambach (1982a:150–152) found that Crenshaw has many areas with

Fourche Maline midden and a few areas with Caddo midden, but these results were the product of limited testing at the site and assessing artifacts from looter pits. The excavation of the antler temple provides evidence of the existence of ceremonial structures at the site based on the material recovered (Schambach 1982a:152). Testing Crenshaw with archaeogeophysics to discover evidence of possible domestic structures could indicate if the Teran-Soule model is applicable to the Early Caddo period in the Great Bend region.

Research Questions

By testing the Crenshaw site using archaeogeophysical techniques, this study intends to answer the following research questions:

1. With the understanding that Crenshaw is a hypothesized Fourche Maline to Caddo transition site, does Crenshaw have any features detectable by archaeogeophysical techniques that disconfirm the hypothesis that the site is a vacant ceremonial center? What does this evidence suggest in regard to the Teran-Soule model for Caddo settlement patterning?
2. What is the overall spatial distribution of features detected via archaeogeophysical prospecting? Is there any evidence to suggest multiple occupations (e.g., Fourche Maline, Caddo) through time? Is there any spatial differentiation suggesting the possibility of separating discrete occupational components?

Chapter 2: Prehistory of the Crenshaw Site

Introduction

The Crenshaw site was occupied by the Fourche Maline culture and the subsequent Caddo culture between ca. A.D. 700 and 1400. These occupations occurred during the Woodland period (600 B.C. to A.D. 900) and the Mississippi period (A.D. 900 to 1500). This chapter will include a brief summary of the culture history of the Great Bend region during these periods to put the Crenshaw occupations in context.

Woodland Period

The Fourche Maline culture dominates the archaeological record in the Great Bend region during the Woodland period (600 B.C. to A.D. 900). The Fourche Maline culture first appeared between ca. 800 B.C. and flourished until about A.D. 900 leaving evidence of more than 700 Fourche Maline sites in southwest Arkansas (Schambach 2001). Frank Schambach (2001:21) argues that, based partially on the occupations at Crenshaw, the Fourche Maline culture developed into the Caddo culture between A.D. 800 and 1000, during the beginning of the Mississippi period. Schambach (1982b:Table 1, 2001:Table 1) has divided the Fourche Maline culture into early (800 to 100 B.C.), middle (100 B.C. to A.D. 500), and late (A.D. 500 to 900) subdivisions. The Fourche Maline culture is abundantly subdivided into subperiods numbered from 1 to 7, from earliest to latest. Subperiods 1 and 2 are classified as early; subperiods 3, 4, and 5 are classified middle; and subperiods 6 and 7 are classified as late (Schambach 2001:Table 1). Diagnostic artifacts include plain pottery, Gary points, Poole pipes, modeled-clay platform pipes, several arrow point types, double-bitted axes, boatstones, and stone grinding tools (Schambach 2001).

The core pottery types of the Fourche Maline culture include four plain types named Williams Plain, Cooper Boneware, Ouachita Ironware, and Ouachita Plain (which is also known as Le Flore Plain). For most of the tradition, clay or grog tempered Williams Plain was the dominant ware. Cooper Boneware, tempered with large pieces of bone, was used only in the early and middle eras. Ouachita Ironware is regionally important in the Ouachita Mountain regions, but is also found in Gulf Coastal Plain sites. It appears with a rusty color and is grit tempered with quartz, hematite, sandstone, novaculite, and mica particles. Ouachita Plain is a square and disc-based jar type with grit temper. There was the occasional decorated pot, but they were either imported or poor to fair copies of Tchefuncte, Marksville, or Coles Creek pottery (Schambach 2001).

The dominant forms of Fourche Maline container were flat-bottomed jars and beakers with a few bowl forms being represented throughout. Over time, there was a change from “straight-sided, straight-rimmed, beaker-shaped, and flowerpot-shaped jars, to jars with pronounced shoulders and flared rims” (Schambach 2001:27). The bases began as disc-shaped, changed to square-shaped, and then reverted back to disc-shaped (Schambach 2001:27). Towards the end of the Fourche Maline culture, gourd-shaped bottles appeared and bases changed from thick to thin. After the end of the Woodland period, the gourd-shaped bottles continued to be used by the Caddo culture (Schambach 2001).

Gary points were commonly used by the Fourche Maline people as projectiles and cutting tools until ca. A.D. 500 based on Frank Schambach’s (1998) work at the Cooper and Means sites. Schambach (2001) suggests that the discovery of only two Gary points and hundreds of arrow points at the Crenshaw site indicates that Gary points were not much in use during the late Fourche Maline era. In Nassaney and Pyle's (1999) analysis of points and debitage from Plum Bayou culture sites in central Arkansas, they suggest that arrow points were introduced around 600 A.D. from Texas and eastern Oklahoma. The earliest Fourche Maline occupation at Crenshaw, located near the Texas and Oklahoma borders, is estimated to have begun between 600 and 700 A.D. Burials from this Fourche Maline occupation contained large numbers of Agee points (Schambach 1982b). The presence of arrow points at Crenshaw between 600 and 700 A.D. conforms to Nassaney and Pyle's (1999) hypothesis. The deposition of arrow points during the latter half of the Fourche Maline 6 subperiod suggests the Fourche Maline were among the first in the southeastern United States to adopt the bow and arrow (Schambach 2001:30). However, the possibility of regional variation is emphasized by the presence of many Gary points at the George C. Davis site (Story 1997).

The Fourche Maline culture had small or medium sized villages with large midden deposits (Hoffman 1994). However, this idea is based on the midden accumulations and not on evidence of structures as there is very little evidence of Fourche Maline houses in the archaeological record. Schambach (2001:31) attributes this to the lack of polished stone celts at Fourche Maline sites. Without them, he states, they would be unable to perform the heavy woodworking necessary to build substantial houses. However, two Fourche Maline structures have been excavated at the Bellevue mound and the Cicero Young mound (3LA7), but were interpreted as used for special purposes (Fulton and Webb 1953:27; Schambach 1982b:146).

There are two possible discoveries of Fourche Maline houses used for domestic purposes, as previously mentioned (in Chapter 1) (Schambach 2001). One is a 30 x 8.5 m rectangular house at the Poole site in the Ouachita Mountains (Wood 1963a:8-11, Figure 3, 1981:11-19). Schambach (2001:31) casts doubt that this house was built by the Fourche Maline people, suggesting that the Fourche Maline graves found near the house were possibly deposited before the house was built, not after. While the certitude of the structure being a Fourche Maline feature is decreased by this possibility, other factors suggest that this structure may still be assignable to this culture. Wood (1981:Table 3) shows that Plot 2, where the structure was located, contained 426 Williams Plain, 30 Williams Incised, and 4 plain body sherds with only eight sherds of other types. He also shows that Plot 2 contained 93 Gary, 20 Ellis, and 13 Bulverde points with only single digit representations of all other types. These representations of Fourche Maline types in the material culture suggest it is more likely that the Poole site structure was built by the Fourche Maline than any other culture even without taking the positioning of the Fourche Maline graves into account.

The second is a house discovered at the Ray site in Lamar County, Texas. While the site has one radiocarbon date from the latter part of the Fourche Maline 7 subperiod, other dates indicate the site was also occupied by the Caddo culture (Bruseth 1998). As Schambach (2001:32) notes, the one meter separation of posts in a large circle found at the Ray site conforms to the evidence from the George C. Davis site where 52 posthole patterns of circular houses have been found (Bruseth 1998; Story 1998). However, the house found at the Ray site should not be ruled out as a late Fourche Maline structure. Schambach (2001:32) also points to two structures at the Martin site, but these may also be early Caddo rather than late Fourche Maline. This difficulty of separating early Caddo from late Fourche Maline structures may indicate that there is a gradual boundary between the Fourche Maline and the Caddo cultures.

Mississippi Period

During the Mississippi period (A.D. 900 to 1500), the Caddo culture occupied the Great Bend region. The Caddo culture was centered on the Great Bend region with settlements in eastern Oklahoma, northeast Texas, northwest Louisiana, and western Arkansas (Hoffman 1994). The timeline of the Caddo culture has been divided into five time periods spanning the beginning of the Mississippi period to the historic era. They are the Formative Caddo (A.D. 800 to 1000), Early Caddo (A.D. 1000 to 1200), Middle Caddo (A.D. 1200 to 1400), Late Caddo (A.D. 1400 to 1680), and Historic Caddo (A.D. 1680 to 1860) periods (Perttula 1996). The major Caddo mound centers in this region include the Battle (3LA1), Bowman (3LR46), Crenshaw, Egypt (3LA23), Foster (3LA27), Friday (3LA28), Haley (3MI1), and Moore (3MI30) sites (Hoffman 1994).

The Teran-Soule model is used to describe Caddo settlement patterns in the Great Bend region with large "vacant" mounded ceremonial centers and dispersed farmsteads lining the river. Caddo sites in the region include small farmsteads, such as the Cedar Grove site (3LA97) located along the Red River, and mound centers, often with cemeteries, as at Crenshaw (Trubowitz 1984; Hoffman 1994). Features at Cedar Grove date to the Middle to Late Caddo periods; these include burials and evidence of three circular houses, one with a postmold diameter of 9.6 m and an area containing daub. High concentrations of daub led to the conclusion that two other possible circular houses were present (Trubowitz 1984:92-95). This suggests that burials were distributed among living areas in the Late Caddo period. Despite the scant evidence for farmsteads in the region, the Teran-Soule model is still reasonable given the likelihood of site selection bias and natural factors. Hoffman (1994:35) suggests that the small number of farmsteads found in the region may be due to disturbance and deposition by the river as well as archaeologists' concentration on the mounded sites.

A recent archaeogeophysical investigation at the Battle site suggests the ceremonial center was not "vacant" and found evidence for possible circular and rectangular structures in the vicinity of the mound (McKinnon 2008). At Crenshaw, Frank Schambach (1982b) found a single Formative Caddo to Early Caddo structure determined to be a ceremonial structure, but he also found Caddo midden just south of Mound F. While the presence of a single off-mound structure at Crenshaw shows that the site was not literally vacant, it does not contradict the Teran-Soule model by itself since it was interpreted to be a ceremonial structure (Schambach 1982b:152). This has been incorporated into the idea of an inner precinct by Story (1997:65-67). She hypothesizes that ceremonies and public functions would be carried out in an inner precinct around a mound which may include off-mound buildings or buildings for residence of civic performers. However, with recent geophysical investigations at the George C. Davis site in northeast Texas (Creel et al. 2008; Osburn et al. 2008) suggesting larger numbers of structures being located further from the mounds, the scope of the inner precinct is being stretched further from the mounds themselves, raising questions about whether it is really an *inner* precinct or alternatively, whether the buildings further from the mounds are not part of an inner precinct and represent domestic space. Excavations of these structures may clear up their function as communal or habitation facilities and if some were contemporaneous. The antler temple at Crenshaw is a significant distance from the nearest known mound, but it, too, was used for special purposes.

> The contents of features 1 and 6 indicate the presence of an important religious specialist whose duties probably included curating human heads and processing them for display or burial – it stands to reason that some, at least, of the many heads and mandibles buried large cemetery to the west and north of this building were processed through it – and the performance of rituals pertinent to hunting whitetail deer [Jackson et al. 2009].

However, it is important to understand that regional and temporal differences in settlement pattern may exist which may account for possible differences between and within sites.

The Caddo culture is defined in part by its unique material culture left in high status mound burials. Ceramic types include "fine ware engraved, incised, or punctated bottles, carinated bowls, and elongated jars" which can be identified as coming from various time periods (Hoffman 1994:32). Other mortuary objects include ear spools, pipes, arrow points, celts, shell artifacts, and copper artifacts (Hoffman 1994: 32). Most of the Caddo may have adopted maize agriculture between A.D.800/900 and 1000/1100 while high caries rates in populations between A.D. 1000/1100 to 1200/1300 suggest uniform adoption (Rose et al. 1998:115).

Several phases have been defined for the Caddo during the Mississippi period in the Great Bend region. The Lost Prairie phase (A.D. 900 to 1200) is represented at Crenshaw and the Bowman site. The Haley phase (A.D. 1200 to 1500) is represented at the Crenshaw, Battle, Bowman, and Battle-Handy sites. The Bossier phase was present during the Middle Caddo period, but may have extended into the beginning of the Late

Caddo period. It was present only in the uplands and is not present at any sites along the Red River (Hoffman 1994:36-37). Late Caddo phases in the Great Bend region include the Belcher and Texarkana phases (A.D. 1500 to 1700), while Historic Caddo phases include the Chakanina and Little River phases (A.D. 1700 to 1800) (Weinstein et al. 2003:Figure 5).

Chapter 3: Archaeological History and Historic Land Use

Introduction

Crenshaw was occupied between A.D. 700 and 1400 by Fourche Maline and Caddo people with the 200 year time span between A.D. 800 and 1000 representing a period of transition from the Fourche Maline to the Caddo cultures (Perttula 1996; Schambach 2001). Early excavations at Crenshaw led investigators to realize there was a culture that immediately predated the Caddo culture in the area, reflected in different pottery styles found with graves (Dickinson 1936; Lemley 1936). Frank Schambach (2001) suggests that the Fourche Maline occupation at George C. Davis was likely earlier than the Fourche Maline occupation at Crenshaw as evidenced by the presence of Gary points. If this is true, then Crenshaw is the only large Caddo ceremonial site known to exist where the Fourche Maline to Caddo cultural transition can be investigated.

Despite Crenshaw having a long history of archaeological investigations, information about this site is not readily available. Some information on this site has been published, but these publications often start with a short description of previous archaeological work at the site then quickly move to a discussion of the current research (Barnes 1992; Durham and Davis 1975; Hoffman 1970; Powell 1977; Schambach 1996; Scott and Jackson 1998; Wood 1962). These works have not been widely distributed beyond state publications. Two relatively recent publications are the exception, but they still only give Crenshaw a short mention (Schambach 2002:110-112; Weinstein et al. 2003:69-70). Another publication, containing a chapter on the faunal remains from the antler temple at Crenshaw, will soon be published (Jackson et al. 2009). Unpublished field notes contain large amounts of information that has never been seen outside of the

University of Arkansas Museum (UAM) and the Arkansas Archeological Survey (AAS) while much information about early work at the site resides at the Gilcrease Museum in Tulsa, Oklahoma (Schambach 1969, 1983; Wood 1963b).

W. Raymond Wood (1963b) created an unpublished manuscript for the UAM containing information from excavations at Crenshaw, beginning with excavations by W.P. Agee in 1906 and ending with the salvage excavation of Mound C by the UAM in 1962. The manuscript is a compilation of excavation results and is useful as a research tool (Figure 3.1). It was meant to be the final product for both the 1939 to 1942 M. Pete Miroir excavations and the 1962 excavations of Mound C by the UAM. It also contains a large amount of data from the 1933 through 1935 Judge Harry J. Lemley and Glenn Martin excavations by the Gilcrease Foundation. However, it is not available outside the UAM or the AAS, needs some corrections, and only contains a short summary. Given the relatively unavailable information on early excavations at the Crenshaw site, this chapter summarizes archaeological investigations done from 1906 to present. All feature and cemetery numbers in this chapter refer to the numbers used by Wood (1963b), although some locations and numbers have been modified to correct errors. All references to cultural affiliations associated with burials and ceramics refer to Wood's (1963b) designations. Also summarized in this chapter is the fieldwork by Dr. and Mrs. R. K. Harrison and Frank Schambach, some of which is summarized in several publications (Schambach 1971b, 1982b, 1982c, 1996). Additionally, in an effort to provide information regarding areas of site disturbance, especially those related to historic occupations, this chapter discusses past land use of the site and how those are represented on the landscape today.

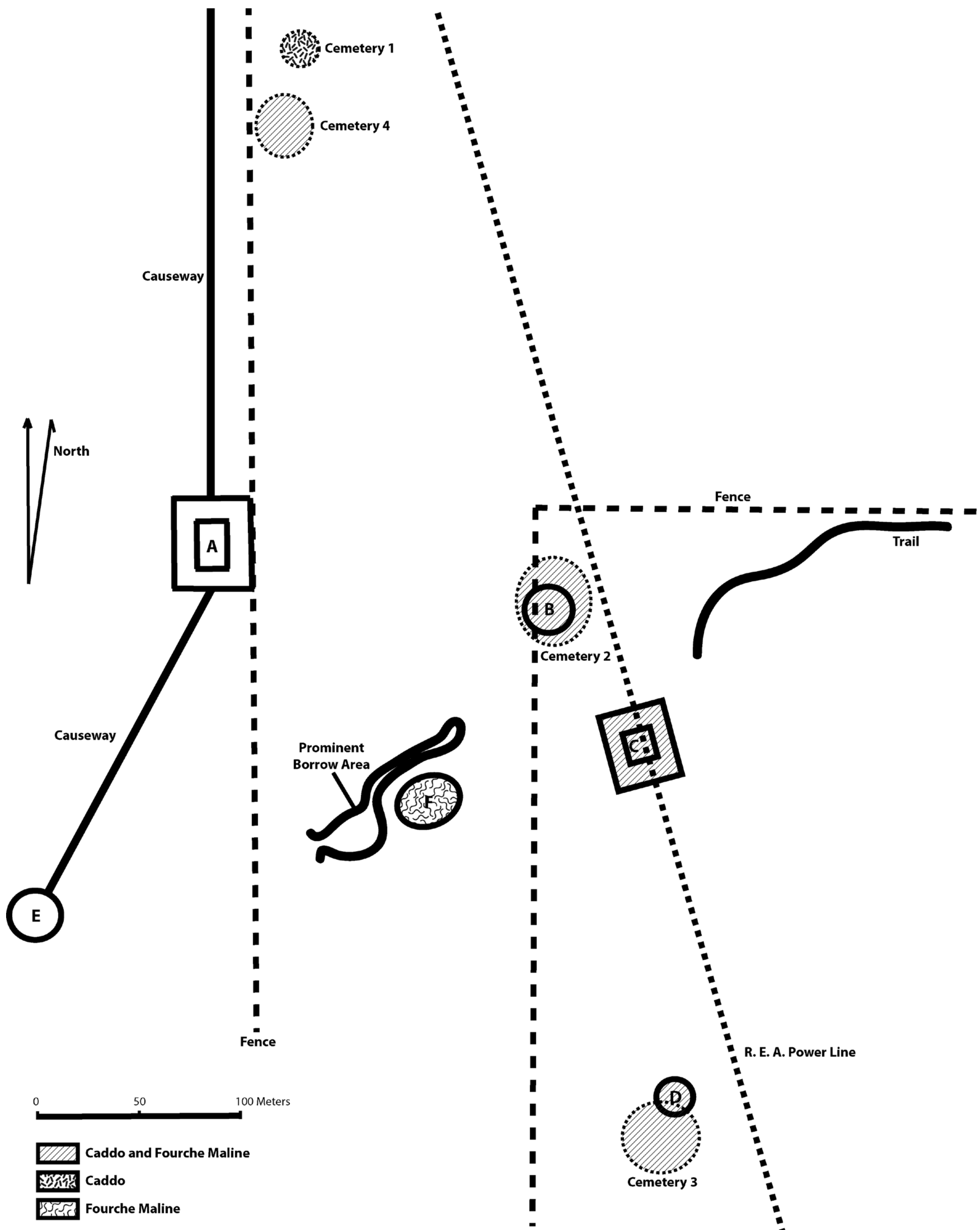

Figure 3.1 – View of Crenshaw with cemeteries found before 1969 (after Wood 1963b:Figure 3).

Historic Land Use

Crenshaw is located near what is now known as Hervey, Arkansas. Hervey used to be a town with several buildings, west of Crenshaw. It is now abandoned and used for agriculture except for two buildings which are used as churches. The greater area around Hervey used to be called the Lost Prairie.

As far as it is known, the Caddos occupied the Lost Prairie until the late 1700's. Osages raids had a devastating effect on the Caddos as they came under heavy attack. In order to escape the vengeance of the Osages, the Caddos migrated out of the Lost Prairie in 1795. With the Caddos gone, local French traders also abandoned the area (Strickland 1940). The Louisiana Purchase of 1803 allowed American settlement in the area. One problem for settlement was the Great Raft which stretched for nearly 320 km and blocked the Red River with fallen trees. It first formed in the 1400s and continued to grow until the final removal took place in 1873 (Bowman 1911; Fenneman 1938). This caused constant flooding and lakes formed around the river channel, making navigation and settlement difficult. The first successful attempt to remove the Great Raft was by Henry Shreve using steamboats between 1833 and 1841, in part due to the importance of transportation for a looming war with Mexico. Shreve was able to secure navigation from Natchitoches, Louisiana to Fort Towson, Oklahoma. Settlers, looking to take advantage of the rich soils of the Red River valley, rapidly increased in numbers as the rafts were cleared (McCall 1988; Smith 1994).

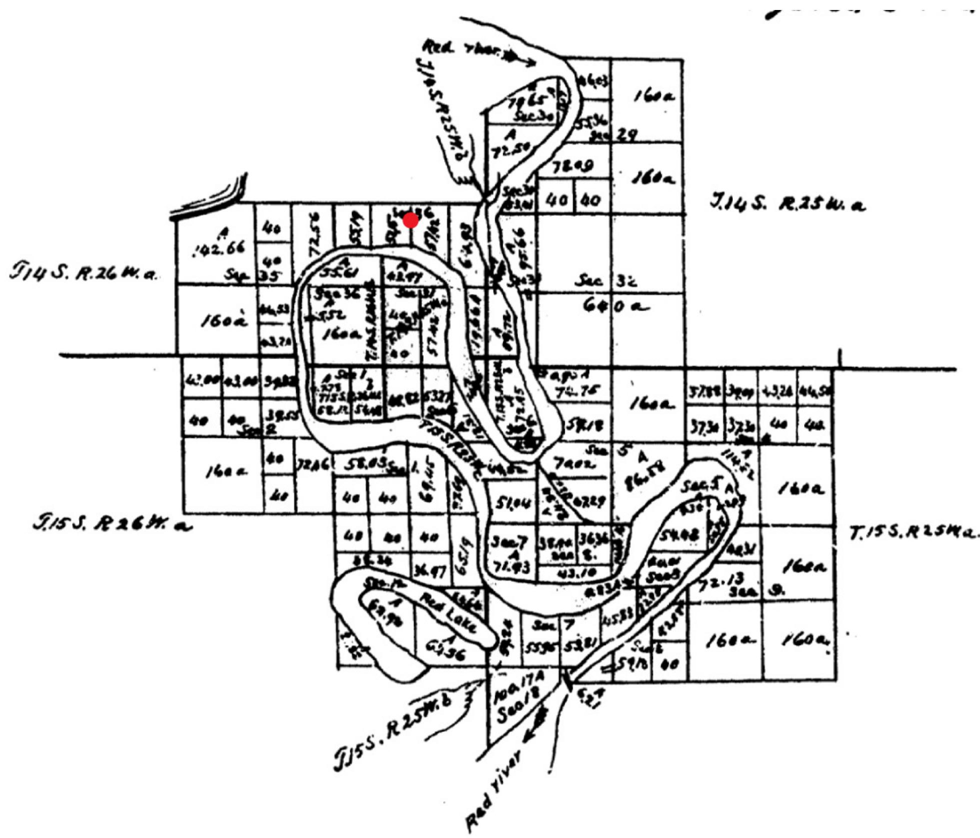

Figure 3.2 – Plats from 1842 in the vicinity of Crenshaw (Arkansas Commissioner of State Lands Office 2000). Crenshaw's location is shown in red.

Plat maps from 1842 show the path of the river around Crenshaw during Euro-American settlement (Figure 3.2). One relict Red River channel, now called Second Old River Lake, was still active. Lot lines are shown on the plat maps, but no buildings or other land use indications are noted. A map drawn by M. A. Miller in May of 1864 of the vicinity around Dooley's Ferry shows Crenshaw surrounded by the Red River and old river channels (Figure 3.3). In this map, the Second Old River Lake is shown as having been cut off from the main river channel, forming the oxbow lake that exists today. The First Old River Lake was still part of the active Red River channel. A portion of the site is shown as owned by a man named Garland C. Crenshaw and the entire site is shown in cultivation. Mr. Crenshaw purchased the land just before the Civil War (Head 1990).

There is one building, but it is substantially to the north of the main part of the site. This building may be 3MI0334, recorded as a late nineteenth century structure in the AAS site files. Forests surround the site on the east and west sides. Unfortunately, the exact positioning of each mound is not included on the map and is subsequently unknown.

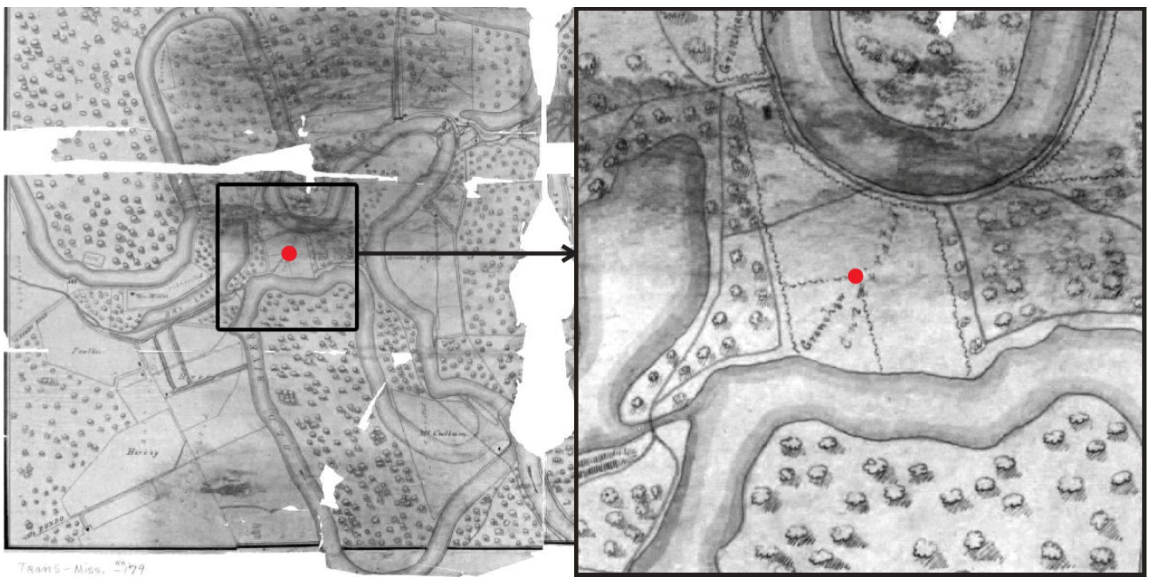

Figure 3.3 – Map drawn in May 1864 by M. A. Miller of the vicinity of Dooley's Ferry (University of North Carolina Library 2009): left, southwest portion of the map; right, area around Crenshaw. Crenshaw's location is shown in red.

When C. B. Moore visited the site in 1912, it was owned by Mr. William Nichol of Pine Bluff, Arkansas. Moore described the site as being used for pasture at the time of his visit. Moore notes that after the great flood of the Red River valley in 1908, stories circulated about great artifact finds at Crenshaw. It is likely that the flood caused some disturbance on the site and deposited artifacts as the water receded. Floods were likely throughout the history of Crenshaw given its location next to the Red River. This could increase the likelihood that cultural material is very deep beneath the surface since floods can also deposit large amounts of soil as muddy waters dry (Moore 1912).

Mrs. Nottingham, the property owner before Dr. and Mrs. R. K. Harrison took over the west half of the site in 1968, recalls visiting the site in 1950 and notes that it was used for pasture at all times after that point. She does not recall if the site was plowed by Mr. Nottingham before 1950 (Head and Head 2009). The Harrisons bought the west half of the site in 1968 for the purpose of performing archaeological excavations. They excavated portions of Mound F and built a cabin on the site. After their excavations, they donated most of the material and records to the AAS. After they finished excavating trenches through Mound F, they back filled the trenches, leaving the form of the mound on the landscape. They then turned their efforts towards preserving the site for future generations (Schambach 2004). The Harrisons left the land to their son-in-law and daughter, Lawrence and Judy Head. The Heads turned the site into a pecan grove during the 1980s, being always careful to preserve intact site features. As part of the pecan business, they disc between the rows of pecan trees every year and have only plowed a small portion of the site at a depth of 20 cm (8 in) on one occasion (Head and Head 2009). The east half of the site, currently owned by the Rayburn family, has been extensively disturbed by decades of farm use and pot hunting (Hoffman 1970).

Evidence collected from multiple sources suggests that the western part of the Head's property was wooded until the 1980s. The first record of that area being forested is the 1864 map (Figure 3.3) which shows a forest west of the cultivation line. Another map made in 1887 shows that portion of the site forested (Figure 3.4). Clarence B. Moore mentions a tree on Mound A and describes Mound E as "in the woods that adjoin the field in which the other mounds are" (Moore 1912:624). With Mound A and Mound E being the western most mounds, it is reasonable that the westernmost portion of the site was wooded between 1864 and 1912. The present forest line provides more evidence for that part of the site remaining wooded through that time as it has not changed significantly over time (Figure 3.5). United States Geological Survey (USGS) aerial photograph from 1948 shows the site with Mound A and Mound E in the forest just like Moore's description. It also shows the same forest line on the southern part of the site as the 1864 map. The north and south line is documented as a fence in Wood's (1963b) manuscript about the site and does not exist today (Figure 3.1). In 1969, parts of the site were deforested, including the area around Mound A (Schambach 1969).

Figure 3.4 – 1887 map of Crenshaw showing the western portion being forested (United States Engineer Department 1886-1892). Crenshaw's location shown in red.

Figure 3.5 – Maps and photos from four time periods show tree lines (marked with red lines): top left, 1864 Drawing (University of North Carolina Library 2009); top right, 1948 Aerial Photo (United States Geological Survey [USGS] 2009); bottom left, 1970 Aerial Photo (USGS 2009); bottom right, 2006 Aerial Photo.

Between 1981 and 1986, all trees (except pecan trees) were cut down on the west side of the site. A County Extension Agent said that most trees were around 40 years old at the time, but some were older (Head and Head 2009). It is possible that at some point between photographs the forest was cleared, but no evidence has been found to corroborate this possibility. If it was cut at any point, the land was not used for anything else for very long. Even in 2006, there is still a noticeable tree line between the old pecan trees and the newly planted pecan trees.

Archaeological History

W. P. Agee: 1906

Before the arrival of C. B. Moore in 1912, a collector from Hope, Arkansas named W. P. Agee and his son conducted the first known excavations at Crenshaw in 1906 (Lemley 1936; Wood 1963b). Agee took no records of his excavation and what information that has survived is contradictory. W. P. Agee Jr. wrote a letter to Harry J. Lemley and W. Kendall Lemley in 1933 describing the excavation that took place in 1906 (W. P. Agee Jr., letter, Lemley Papers, Gilcrease Museum of Tulsa, Oklahoma). In this letter, Agee states that he collected 11 pottery vessels and 276 very high quality projectile points from a single mound. Lemley (1936) uses this letter as a basis for determining that Agee had found those materials in the northern part of Mound D. However, in Agee's letter, it states that the mound where this material was found was "completely excavated down to the surface" suggesting that Lemley mistakenly assigned this material to Mound D as it was not completely excavated until 1935 (Agee, LP, Tulsa, 1).

Discussions with Glen Kizzia in 1965 prompted Agee to recall the complete excavation of a seventh mound named tentatively as Mound G by Durham and Davis (1975). It was reportedly 27.4 m (90 ft) southwest of Mound F, 28 m (92 ft) long, 9.1 to 12.2 m (30 to 40 ft) wide, and 1.2 to 1.5 m (4 to 5 ft) high containing Fourche Maline material. Agee stated that it was fully leveled before C. B. Moore arrived in 1912, so it was not documented by Moore (Durham and Davis 1975). Frank Schambach (personal communication 2009) thinks Agee's placement of Mound G is dubious and its location could be at the north end of the causeway that originates from Mound A. The possibility that Mound G is not located where Agee describes is increased by the small distance between Mound F and Mound G. Considering that Mound F and Mound G would both be wider than the distance between them, it is questionable that they would have been only 27.4 m (90 ft) apart. Furthermore, Agee's 1933 letter states that the mound was circular, 33.5 m (110 ft) in diameter, and 3.3 m (11 ft) high which conflicts with the statement made in Durham and Davis (1975) (Agee, LP, Tulsa). If it was excavated, it is possible that a significant portion of the mound may still be present beneath the surface since Agee's letter states that they did not excavate below the surface of this mound. The presence of a Mound G is still in question and needs to be independently confirmed. Future archaeogeophysical work may be instrumental in detecting these remains.

Clarence B. Moore: 1912

When Clarence B. Moore visited Crenshaw in 1912, he found some surface material, but the site was well buried and yielded little. He described the 6 mounds' condition (Figure 3.6). Mound A was oblong in shape, measuring 3 m (10 ft) tall and 45.7 m (150 ft) in basal diameter with a platform measuring 24.4 m (80 ft) north and south and 15.8 m (52 ft) east and west. He suggested that Mound A was originally square despite its present round shape. Mound B was 1.7 m (5.5 ft) tall and made of mostly clay with sand. The mound had a basal diameter of 25.9 m (85 ft) forming an irregular circle. Mound C was a quadrangular platform mound before erosion modified the shape of the sides. The mound measured 38.7 m (127 ft) across and the platform was 13.7 x 16.5 m (45 x 54 ft). Mound D was described as made entirely of sand and was disturbed by a previous excavation. Moore measured the mound at 15.2 x 9.1 m (50 x 30 ft) and 1.8 m (6 ft) tall. Mound E was a circular mound with a diameter of 25.9 m (85 ft) and 2.1 m (7 ft) tall. Mound F was 6.4 m (21 ft) tall and had an elliptical shape measuring 25.6 x 32.3 m (84 x 106 ft). The mound was made mostly of clay with sand (Moore 1912).

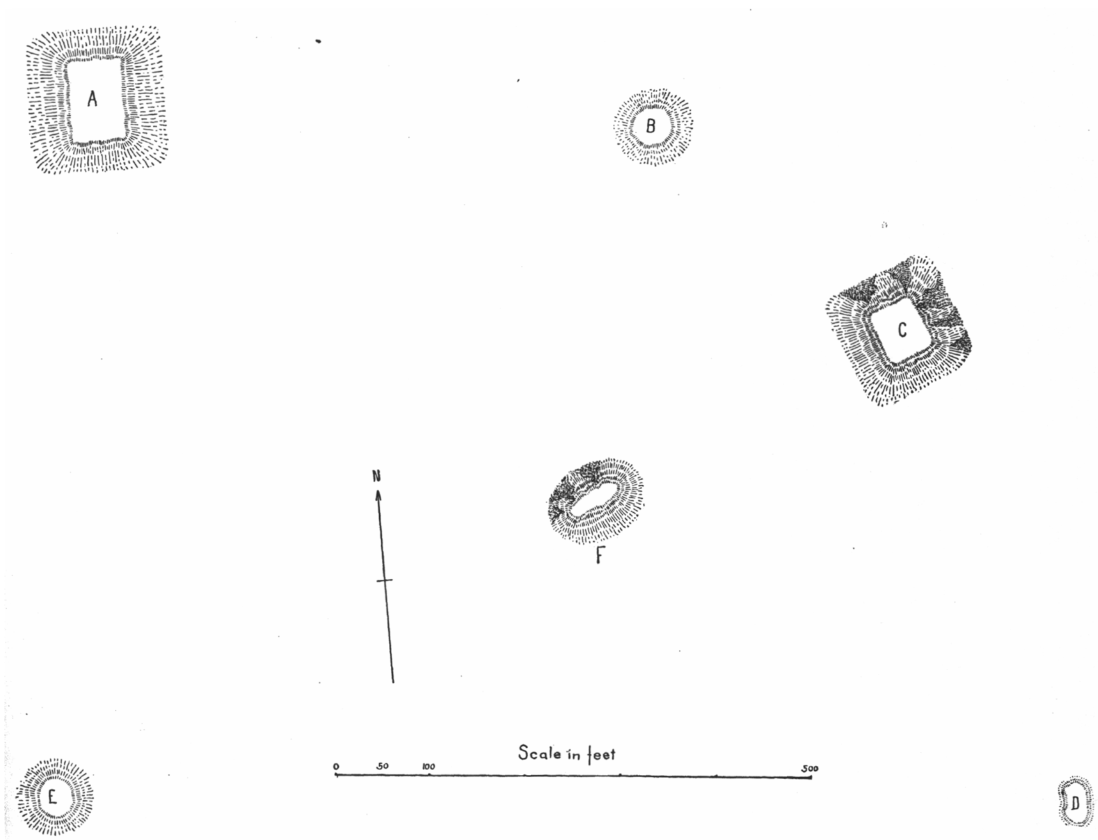

Figure 3.6 – Map of the mounds at Crenshaw (from Moore 1912:Figure 122).

Moore (1912) discovered 13 burial pits containing 33 individuals in Mound B, Mound C, and Mound D. He dug trial holes in Mound A, Mound E, and Mound F but no burial pits were found. He found five burial pits in Mound B containing at least 24 individuals. One burial pit in Mound B contained assorted bones, including 17 skulls divided into two piles and 10 whole vessels. The five vessels from Mound B that were displayed by Moore (1912) were made by the Caddo. Unfortunately, records of the other five vessels were not kept, so their cultural affiliations are unknown (Lemley 1936). In Mound C, he found three burial pits containing three individuals, one of which included sheet copper. In Mound D he found five burial pits containing six individuals. The burials in Mound D were decayed to the point that in one burial pit, all that was left were the crowns of the teeth. Another burial pit consisted of two skulls while another contained a cranium. Most of the seven vessels found in Mound D were undecorated and burial pits often had no artifacts. He noted that the ceramics from the site had an overall poor quality with a few exceptions.

Judge Harry J. Lemley and Glenn Martin: 1933-1935

Glenn Martin of Texarkana excavated Cemetery 3, the upper portions of Mound B, and Mound D in 1933 and 1934. Judge Harry J. Lemley and S. D. Dickinson became interested in Crenshaw when Martin displayed some of the findings from his excavations. Lemley decided to continue excavations at Crenshaw in 1935 with Martin as the field foreman (Lemley 1936). In 1935 they mostly completed the excavation of Cemetery 3 and Mound D, leaving only a strip 2.4 m (8 ft) wide standing.

Mound B was excavated between 1933 and 1935 by Lemley and Martin and was excavated to its base. In 1933, Martin excavated the upper portions of the mound, finding 17 burials, all of which were Caddo burials. In 1935, Martin and Lemley returned to Mound B and continued the excavation. Five Fourche Maline burial pits were found beneath the mound, underneath the original land surface. Twelve Caddo burial pits were found in the upper part of the mound or down intrusively through the Fourche Maline pits. There was also an infant burial of unknown cultural affiliation. It is important to note that M. P. Miroir's 1941 through 1942 excavation of Cemetery 2, which also contained some Fourche Maline burial pits, is in the immediate vicinity of Mound B (Wood 1963b). This pattern of Caddo burials cutting intrusively into Fourche Maline burials caused Lemley to determine that there was another occupation predating the Caddo occupation at Crenshaw. At that time, the earlier occupation was considered to be Coles Creek, not Fourche Maline (Lemley 1936).

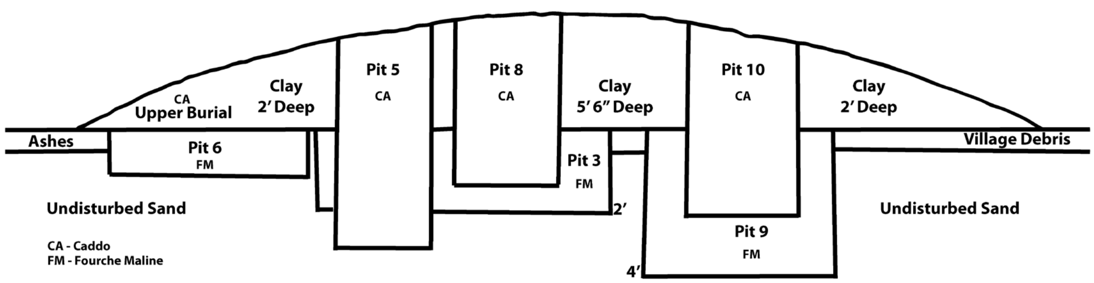

Figure 3.7 – Cross section of Mound B facing west (after Judge Harry J. Lemley and Glen Martin, field notes, Lemley Papers, Gilcrease Museum of Tulsa, Oklahoma).

Martin calculated the original shape of Mound D as circular measuring 18.3 m (60 ft) in diameter and 2.3 m (7.5 ft) tall with layers of sand separated by thin layers of clay (Lemley 1936). Martin and Lemley excavated Mound D between 1933 and 1935 starting with the 20 to 30 centimeter (8 to 12 in) thick midden layer and moving toward the mound. They excavated nearly the entire mound finding mostly badly preserved Fourche Maline burials and two Caddo burial pits. Some Fourche Maline burials started from within the mound, suggesting that the mound was capped off in stages after the burials. Many of the Fourche Maline burials were disarticulated including skull burials. The two

Caddo burial pits were intrusive into the mound from the surface. There were also four cremations presumed to be affiliated with the Caddo (Wood 1963b).

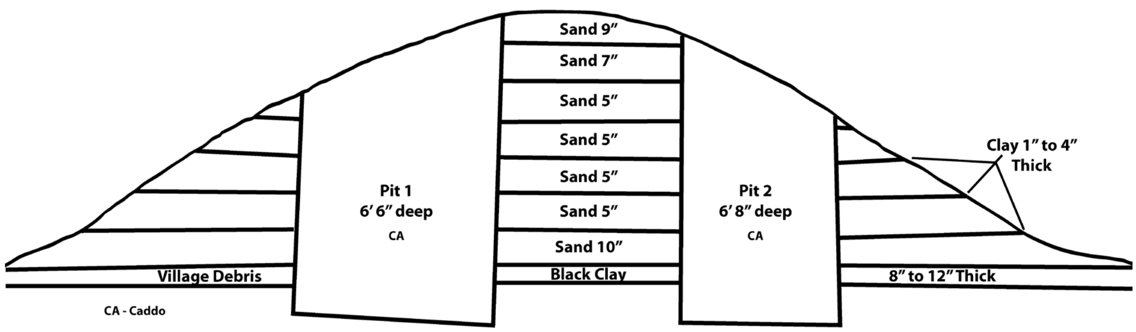

Figure 3.8 – Cross section of Mound D facing north (after Lemley and Martin, LP, Tulsa).

Cemetery 3 is located south and southwest of Mound D and was first excavated by W. L. Griffin and his son in 1934. Unfortunately, no records were kept of their work. However, Lemley purchased the collection and donated it to the Gilcrease Foundation. Some of the burials were determined to be Fourche Maline while others were Caddo (Wood 1963b). In 1935 Martin dug in the field south of Mound D and excavated 34 burials, mostly Fourche Maline with some Caddo burials.

Glenn Martin and M. Pete Miroir: 1938-1939

Glenn Martin returned to Crenshaw in 1938 with M. P. Miroir and found what Wood (1963b) called Cemetery 4 about 274 m (300 yd) northwest of Mound B. There they found three Fourche Maline burials and one Caddo burial in a plowed field along a natural rise that extended along a northwest to southeast line. He dug a trench nine meters (30 ft) northwest of the cemetery. Only 51 cm (20 in) beneath the surface, he found a layer of burnt cane that continued in every direction. This suggests that it was a burnt structure. Unfortunately, he was unable to continue the excavation due to the imminent planting of corn in the field (Wood 1963b).

There is a discrepancy in the accounts of the location of this cemetery. Wood (1963b) separates Martin's three burials and Miroir's single burial into two different cemeteries, Cemetery 1 and Cemetery 4. However, based on Miroir's notes, he says the location of the single Caddo burial is in the same location as the three Fourche Maline burials Martin found. Miroir describes the location of the cemetery as 175 m northwest of Mound B while Martin describes the location as 274 m (300 yd) northwest of Mound B, probably causing this error (Miroir 1942). Based on a recently constructed topographic map, the location is likely 274 m (300 yd) northwest from Mound B as this is where a northwest by southeast rise is located and is described by both Martin and Miroir as the location of this cemetery (Figure 3.9). The author reassigns this location, where Miroir found one Caddo burial and Martin found three Fourche Maline burials to Cemetery 4. These burials correspond to Wood's (1963b) burials 70, 107, 108, and 109. This dissolves Wood's (1963b) designation of Cemetery 1 and Cemetery 4.

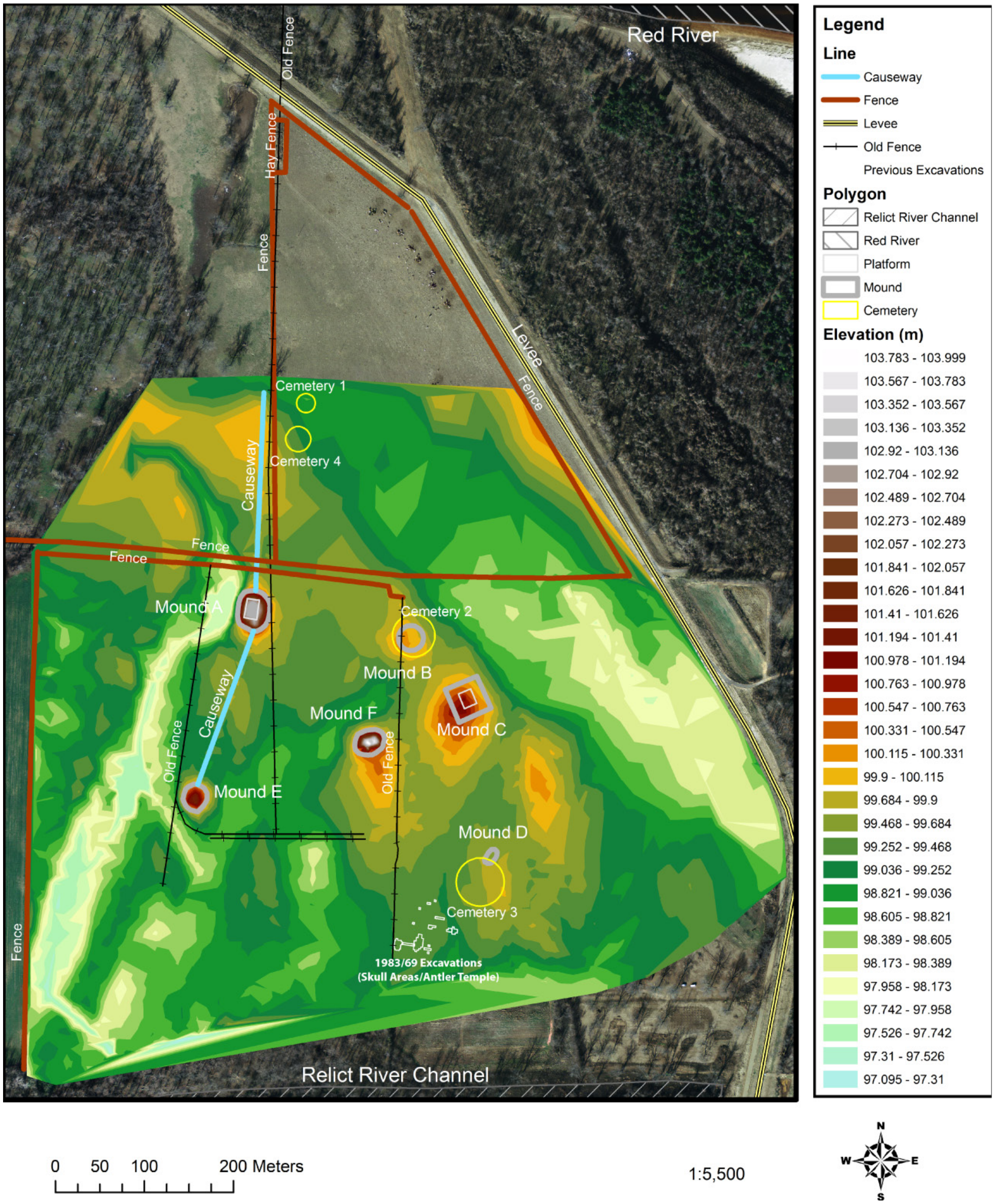

Figure 3.9 – Map of Crenshaw including excavations in 1969 and 1983. Positions of Mound B, Mound C, Mound D, and all cemeteries are approximate. Topographic data collected by Michael Evans, Jared Pebworth, David Jeane, Barbara Burnett, and Frank Schambach in 2006.

Miroir returned to Crenshaw in 1939. He assigned another cemetery number to a location 40 m north and a little east of Cemetery 4 where he found a black refuse layer 30 to 46 cm (12 to 18 in) thick. He found one Caddo burial pit here, which corresponds to Wood's (1963b) burial 71. He also discovered loose human remains on the surface (Miroir 1942). For this study, this location is referred to as Cemetery 1.

M. Pete Miroir: 1941-1942

Miroir excavated around Mound B at Crenshaw between 1941 and 1942. The burial pits discovered in the area around Mound B constitute Cemetery 2 (Wood 1963b). The burial pits contained both Fourche Maline and Caddo individuals. A majority of the burial pits were discovered on the north slope of the mound (Figure 3.10). From Miroir's notes, housed at the University of Arkansas Museum, one burial pit was located on the west slope of the mound, two on the south slope of the mound, and two burial pits east of the mound (Miroir 1942). While digging a burial pit north of the mound, he noted that a layer of midden lay on top of a thick layer of river sand and extended north, east, and west of Mound B. Below the layer of river sand, he discovered a burial pit (Figure 3.10:Burial 75) on the north slope of Mound B. Some burial pits were as deep as 163 cm (64 in) beneath the surface.

> North, East, and West slope of Mound B. Through pure accident a small cemetery was located on a small rise on which Mound B is located, just north of the mound. It seems that sometime after the burials were made, the river deposited a layer of sand over this area, and still later, more Indians lived here, forming a fairly deep midden on the present surface. By accident this sand layer was penetrated by the writer at one point, and a grave was encountered which we will call CM-B4 [Miroir 1942:2].

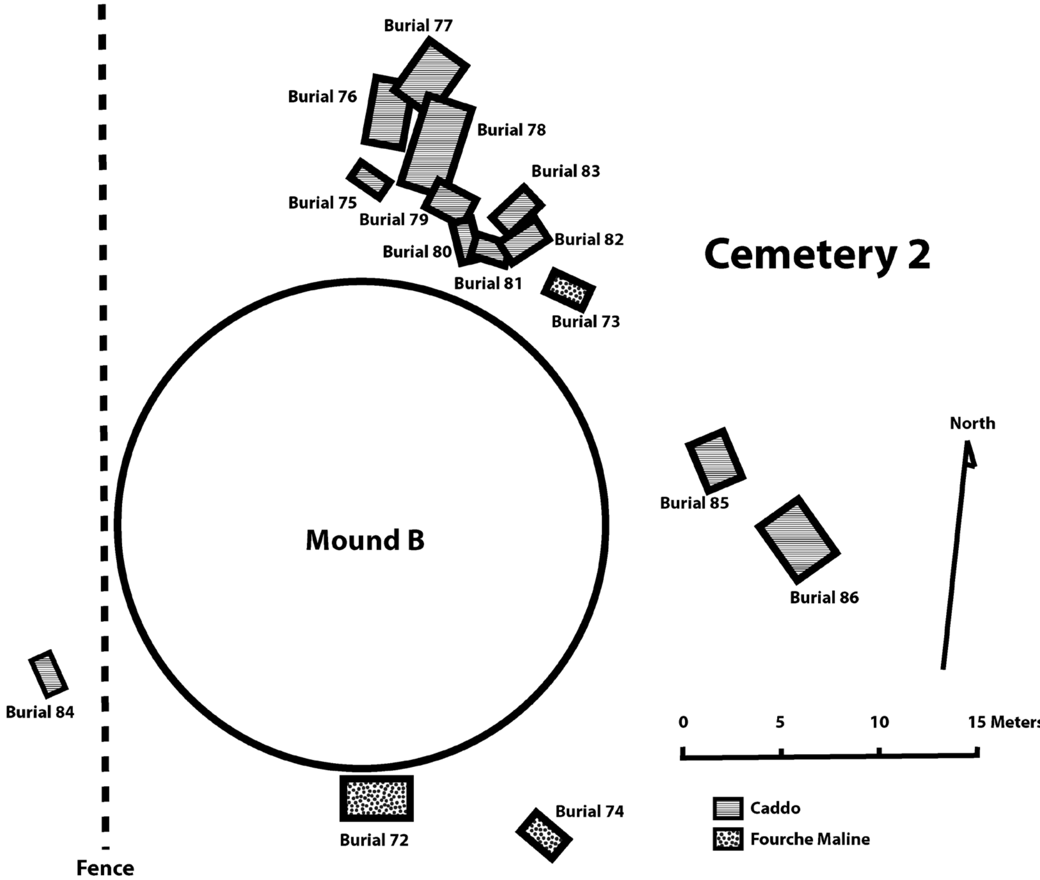

Figure 3.10 – Overview of Cemetery 2 (after Wood 1963b:Figure 20).

There was only one burial pit on the west slope of Mound B. It was 122 cm (48 in) deep and had 46 cm (18 in) of midden over it. The outer edges of the Caddo burial pit were clearly visible when the layer of river sand was uncovered. This suggests a Caddo occupation deposited midden in the area west of Mound B after the burial was made. In Miroir's notes he describes this burial (Figure 3.10:Burial 84):

> Burial No. CM-13. This grave was encountered on the west slope of the mound and was 48 inches deep. Grave outline was very clear after the 18 inch midden had been penetrated. Remains of three adults were found. Skulls were in a fair state of preservation (well enough to determine that this was an adult burial) but length of skeletons was more or less guess work; but, without a doubt the people were very small, the center skeleton having a length of only 58 inches. Found

> with this burial were two water bottles, one bowl, and a beautiful long stem pipe. This was definitely a Caddo Burial [Miroir 1942:4].

It is important to note that Mirior's excavation of Burial 84 took place after Mound B was excavated. Therefore, it is possible that the 46 cm midden may have actually been mound fill deposited to the west of the mound during its excavation. Miroir notes that he trenched in the level fields of the site and around the mounds, finding nothing until Cemetery 2 around Mound B. The absence of burial pits in the level fields of the site is an important point, raising the possibility of other uses such as habitation or public use areas. The exact location of Miroir's excavations in level fields is unknown.

Glen L. Kizzia and the University of Arkansas Museum: 1961-1962

Mound C at Crenshaw was almost completely excavated in 1961 by Glen L. Kizzia, Joe N. Shurtleff, and other collectors from Texarkana. Kizzia received permission from the land owner, Mr. Morrison of Texarkana, to excavate Mound C by leasing the mound for one year. One 5.2 m (17 ft) deep Caddo burial pit was discovered and had a large number of mortuary artifacts of high quality (Durham and Kizzia 1964). Most of the mound was excavated except for a small portion near the center which was later excavated by the University of Arkansas Museum in 1962 (Figure 3.11). Both Fourche Maline and Caddo burial pits were found in Mound C. The Fourche Maline burial pits were mostly group burials including one burial pit containing 43 individuals. The Caddo burial pits contained between one and five individuals and were very deep pits dug from the surface of the mound. A total of 22 burial pits were excavated from Mound C. The burial pits dug by Kizzia were given letters from A through T (Durham and Davis 1975).

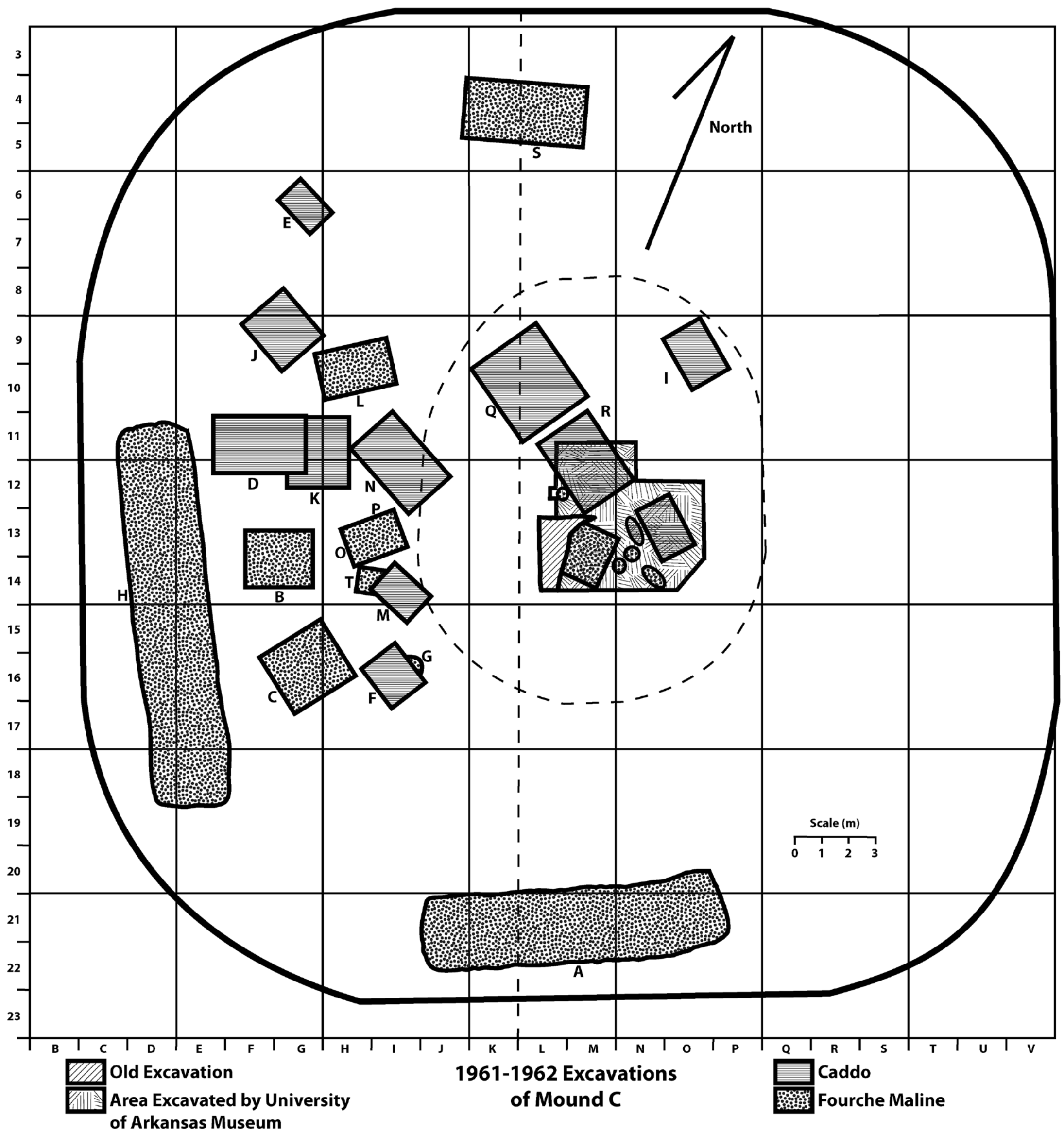

Figure 3.11 – 1961-1962 excavations of Mound C. Original map drawn by Glen L. Kizzia (after Durham and Davis 1975:Figure 2).

Wood (1963b) described three phases of mound building in Mound C, two associated with Fourche Maline culture and one associated with Caddo culture. Durham and Davis (1975) divided the construction of Mound C into five mound building phases, four Fourche Maline phases and one Caddo phase. These phases correspond to the five strata with the final layer, built by the Caddo culture, creating a platform (Figure 3.12). They used comparable site data to conclude that the Fourche Maline phases of the mound were built between A.D. 800 and 1000, and the Caddo phase was built between A.D. 1000 and 1200 (Durham and Davis 1975).

Frank Schambach (1982b) notes a particularly important burial pit in Mound C bridges the gap between Fourche Maline and Caddo burial practices. Wood (1962) excavated a large rectangular burial pit containing multiple individuals in Mound C that contained abundant artifacts including diagnostic late Fourche Maline pottery. It was intrusive into the mound from his Stage 2 which was a Fourche Maline stage. The evidence of multiple burials with Fourche Maline pottery reflect Fourche Maline burial practices while the evidence of abundant offerings and intrusive mound burials indicate Caddo burial practices (Schambach 1982b).

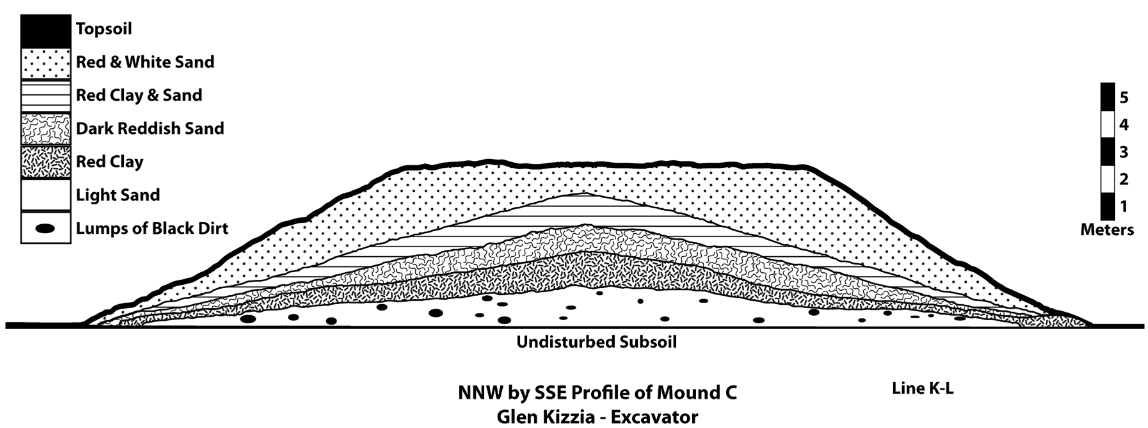

Figure 3.12 – Cross section of Mound C on the K-L line (after Durham and Davis 1975:Figure 3).

Dr. R. K. Harrison: 1968

Dr. and Mrs. R. K. Harrison purchased the property in 1968 for the purpose of conducting their own amateur archaeological dig. Frank Schambach arrived at the site after most of the digging was complete. He worked with Jim Scholtz, the station archaeologist at Arkadelphia, and Martha Rolingson, the station archaeologist at Monticello, to document what he could of the dig. The Harrisons dug three trenches into Mound F heading from south to north. Two of the trenches were three meters (10 ft) wide and the other was 6.1 m (20 ft) wide. They found seven undecorated vessels and 40 or 50 Agee points associated with one burial pit containing at least 30 individuals underneath the mound. No decorated sherds were found, suggesting a Fourche Maline cultural affiliation. The seven vessels are Mississippi Valley types dating from A.D. 700 to 800. Schambach (1982b) suggests that since the burial pit was visible in all three trenches, it is possible that as many as 30 more individuals were buried in the pit, but were not visible. Upon uncovering the graves, red and green clay was apparent under some of the individuals, but disappeared shortly after exposure. Some of the individuals were deposited as bundle burials and had been stored in a charnel house or some other location before being buried (Arkansas Archeological Survey [AAS] 2009; Schambach 1982b).

On top of the burial pit was a fairly clean sand layer 45 to 60 cm thick which contained some small artifacts. Over the sand layer was a rich ash layer 5 to 10 cm thick. This layer contained artifacts and animal remains in large pieces, indicating that they were not walked on. This suggests that the rich ash layer may have been deposited as a feast refuse pile. A radiocarbon sample from wood charcoal in this layer returned a date of A.D. 900 ± 70 (Tx 1357). The mound appeared to have been erected in a single stage amounting to 4 m of fill on top of the rich ash layer, probably erected directly after the feast (AAS 2009; Schambach 1982b).

Frank Schambach: 1968-2006

As the Southern Arkansas University Station Archaeologist for the AAS, Frank Schambach, after discovering that Mound F was being excavated, also discovered that the southeastern portion of the site was being dug by the Rayburn family. Unfortunately, there was no record keeping of those excavations and artifacts were dug up for collection and sale. Graves were often dug into to retrieve the associated artifacts and not backfilled. Schambach documented as much about these excavations as possible including pictures of ceramics and written notes about location and cultural affiliation of the finds (AAS 2009).

Schambach documented 10 vessels from Cemetery 5 which was located west of the Rayburn’s house and southeast of Mound C. Some of the vessels were found in association with badly preserved and plow disturbed burials while others have no information about their association. The vessels suggested that the cemetery was made by the Fourche Maline culture. Cemetery 6 is a well preserved Caddo burial area located southeast of the Rayburn’s house and east of Mound D on the opposite side of the farm road. Schambach recorded four Caddo vessels associated with burials here. He also noted that Cemetery 7 was a Caddo cemetery, but that it was later than Cemetery 6. Cemetery 7 is located east of the Harrison’s cottage just across the fence that separated the two properties. Schambach noted a pattern of burial pits with up to four individuals and multiple vessels associated around the heads. He documented four Caddo vessels from this area and noted that these burials might be associated with a house (AAS 2009).

Frank Schambach began his own off-mound excavation at Crenshaw in 1969 where he discovered two features of particular interest. He excavated two plots on the Rayburn's property with their permission. Plot 1 was located on the east side of the fence separating the Harrison and Rayburn properties and on the south edge of the property near Second Old River. Within Plot 1 were Feature 1 and Feature 6, which are better known as the antler temple. These features were located in the southwest portion of Plot 1, designated as Area 1. In Area 4, the northeast portion of Plot 1, was midden containing a ceramic assemblage that dated to Hoffman's Crenshaw Phase (Hoffman 1970). A radiocarbon sample from a small pit hearth here returned a date of 890 ± 60 (Tx 1354) (Schambach 1982b). Plot 2 was about 100 m east of Plot 1 and located on a small rise southeast of Mound D. Deep midden was identified in Plot 2 that continued indefinitely to the west. Thin sherds, some with decoration, found on the north edge of this plot suggested a possible Caddo component while thick plain sherds found on the south edge suggested a possible Fourche Maline component. Shovel and auger testing was done around proposed Plot 3, located just south of the Rayburn's house on a small ridge. The area around Plot 3 had midden 38 to 51 cm (15 to 20 in) deep over the entire area, but no excavation was performed due to the discovery of Features 1 and 6 in Plot 1 (Schambach 1969). Besides these three plots, Schambach discovered an area containing Caddo midden south of Mound F. He suggests that a structure could be located in this area based on the concentration of Caddo debris (Schambach 1982b).

Feature 1 consisted of a pile of 2042 antlers representing a minimum of 1021 deer (Figure 3.13). Schambach estimates the actual number of deer is above 2000 due to loss of antlers to decomposition and disturbance. In addition to antler, pieces of human skulls were found around the pile, possibly broken due to plowing. The presence of human skulls ties this feature to the 1983 excavations in the West Skull Area and the North Skull Area. Furthermore, Mound D contained several burials of skulls and lies to the northeast (Schambach 1996).

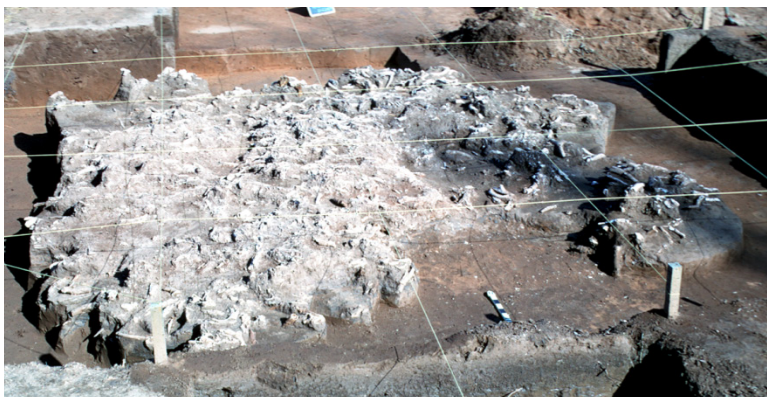

Figure 3.13 – Pile of 2042 antlers (Feature 1).

Feature 6 was discovered on the north edge of Feature 1. It was an ash laden floor in a roughly rectangular shape measuring nine meters and containing domestic debris. The pottery suggested that the house dated to between A.D. 800 and 1000, and was associated with the Lost Prairie phase (Schambach 1996). Radiocarbon dates confirmed this indicating that the house was occupied between A.D. 900 and 980 during the Lost Prairie Phase (AAS 2009). Evidence of handling of skulls was found in this feature including 73 teeth representing at least 10 people and pieces of mandible (Powell 1977). This in combination with the presence of beads, bone pins, and remains of many birds likely acquired for ceremonial purposes, such as blue jay, yellow-billed cuckoo, long eared owl, grackle, redwing blackbird, and mockingbird, suggest that headdresses were created for the skulls or other fabric such as cloaks or coverlets were being created. The animal remains also included bear and cougar. Other ceremonial objects found in the house include tobacco pipe fragments, marine shell beads, freshwater pearl beads, finely carved bone pins, and native copper bangles and beads (Schambach 1996).

Although this is interpreted as a structure, no postmold pattern appeared during excavation. Instead the type of material found and the way it was deposited, along with the shape of the feature, was used as evidence. Postmolds seem to have particular difficulty retaining color and shape in the sandy soil at Crenshaw. Schambach (1969) noted that pits in this area also had very indistinct boundaries with sand mixing around the edges. One pit was dug through to the subsoil without the excavators noticing they were in a pit. Since the change in color was too gradual, they didn't notice the color contrast until it was visible in the profile.

Skulls were occasionally being plowed up or found by relic hunters in the area north of the antler temple, called the Plaza of the Skulls. In 1983, Frank Schambach conducted a salvage excavation just west of the antler temple where a pile of skulls was discovered by the Rayburn family. This area was called the West Skull Area. During the excavation, 91 complete human skulls were found in pits and 216 detached mandibles were found in separate pits. The skulls were often found forming piles so that they lay on top of each other. A few skulls were also found just to the north of the antler temple in the area called the North Skull Area. Since the 1983 excavation 15 additional skulls were plowed up just south of the West Skull Area. There is a question whether these individuals were buried in this fashion because they were enemies of the Caddo at Crenshaw (Schambach 1983, 1996). The association with the antler temple suggests that the skulls were deposited between A.D. 800 and 1000. However, absolute dating techniques would improve this link. Barbara Burnett is currently working on her dissertation at the University of Arkansas to determine if these individuals were Caddo people or from another population.

In 2006, Frank Schambach returned to Crenshaw with Barbara Burnett, Michael Evans, Jared Pebworth, and David Jeane to produce a topographic map of the site. Data was collected on most of the southern portion and part of the northern portion of the site with a digital total station. This is the first time Crenshaw has been mapped since C. B. Moore's 1912 excavation and is an invaluable resource. The topographic data collected in 2006 is shown in Figure 3.9.

Conclusions

Every cemetery contained both Fourche Maline and Caddo burials with the exception of Cemetery 1 which had only one Caddo burial. However, Cemetery 4 contained Fourche Maline burials and is very close to Cemetery 1. The mounds that have been completely excavated, Mound B, Mound C, and Mound D, all contained Fourche Maline and Caddo burials. Mound F contained only Fourche Maline burials, but has only been partially excavated. This suggests that most of the site was used by both the Fourche Maline and the Caddo cultures, at least for burial purposes. Mound C and Mound D both had Fourche Maline burials that began beneath and within the mounds with Caddo burials intrusive from the upper portions of the mounds. These mounding episodes show that the Fourche Maline people constructed and used these mounds with the later Caddo people digging burial pits from the tops of the mounds. In the case of Mound C, the Caddos capped the mound to create a platform mound. With Mound B, all Fourche Maline burials are beneath the mound and the Caddo burials started from within the mound. This evidence from Mound B suggests that the area was first used as a surface cemetery by the Fourche Maline people with the latest grave being mounded over. The Caddos made burials intrusively into the mound sometime later. The Fourche Maline and the Caddo people also used the area around Mound B as evidenced by Cemetery 2 (Figure 3.1). Interestingly, Cemetery 2 and Mound B are the only burial locations (excluding Cemetery 1) that contain more Caddo burials than Fourche Maline burials.

The excavation of Mound F was not a complete excavation and more information may be contained within the mound. The Fourche Maline burial pit in Mound F may not be the only burial pit present. It is large enough to underlie a greater part of the mound as it was present in all three trenches making the possibility of other Fourche Maline burials very likely. Frank Schambach (1982b) suspects as many as 60 individuals may have been buried here, making it the largest burial pit on the site. The burials in Cemetery 5, Cemetery 6, and Cemetery 7 were dug under very awful conditions, so the information from these cemeteries should be viewed skeptically beyond the primary information recorded by Frank Schambach.

Wood (1963b) noted that under Mound B, Mound C, and Mound D was a layer around 30 cm (1 ft) thick of dark soil containing village debris. Considering that the Caddo burials were intrusive into these mounds and the Fourche Maline burials were either below or within the mounds, it suggests that this village layer was deposited by a

Fourche Maline occupation. Additionally, it is possible that there are areas on the site that have a thick midden layer that was deposited by an early Caddo occupation. For example, Miroir's discovery of a Caddo burial pit on the west slope of Mound B beneath 46 cm (18 in) of midden and through a thick layer of river sand may suggests an early Caddo occupation exists west of Mound B. However, it is possible that the midden above the burial was backdirt from the excavation of Mound B, as the burial was discovered years after that excavation.

The southwest area of the site, south of Mound F and west of the current property line, has not been investigated by previous researchers. Given that there are no mounds and a forest had covered a large portion of this area, a study to determine what kind of cultural material may be present in the area would add much to our understanding of the site. The west area, north of Mound F and south of the road, has been largely uninvestigated. The only known report of discoveries on that side of the site is Miroir's identification of a single Caddo burial pit below a midden 46 cm (18 in) thick. Besides the small amount of research by Miroir and Martin north of the current road that divides the site, little has been done on the northernmost part of the site, some of which is still forested (Figure 3.9). Particularly encouraging is Martin's discovery of a burnt cane structure in that area of the site (Wood 1963b). However, it was being cultivated and used for corn so the level of disturbance is uncertain. The eastern portion of the site, while having been largely disturbed, could benefit from a geophysical survey to determine what may still be intact. The concentration by earlier researchers and collectors on the mounds and burial pits highlights the possibilities of understanding the Fourche Maline and Caddo occupations by conducting research in the off-mound areas of the site. The antler temple and skull piles excavated by Frank Schambach are a good example of this as they provide archaeologists with insight into an interesting and seemingly atypical cultural practice (Schambach 1969, 1971, 1982b, 1982c, 1983, 1996).

Archaeological investigations at Crenshaw have been scattered over a century and without consistent excavation techniques or record keeping. By compiling the information from these excavations in a summary, the archaeological information from Crenshaw is put into proper context. This information supports the idea that Crenshaw is unique in its potential to reveal new insights concerning the transition from the Fourche Maline culture to the Caddo culture. These revelations can help modern Caddo Indians understand their cultural roots. The historic land use of Crenshaw is important for future studies to document what kind of disturbance has taken place at the site. Furthermore, knowing the locations where the disturbance is small can enhance the selection of areas for future study.

Chapter 4: Geomorphology of the Crenshaw Site

Introduction

Understanding the geomorphology of a site such as Crenshaw is useful for determining how the landscape surrounding the site has changed over hundreds of years. River meanders can completely erode entire landforms. New fluvial landforms are deposited behind the meanders that leave no trace of the cultures that existed there in the past. Understanding the changing position of a river channel over time may reveal locations where new sites are likely to be found and may enable archaeologists to determine the position of the river at the time a site was occupied. This can also aid in the determination of site boundaries as areas that have been destroyed by the river are definite boundaries where the site ends. If cultural materials are found near this boundary, it might suggest parts of the site have been eroded by the river. The soils deposited at a site affect associated materials and burials which may, depending on the soil type, increase decomposition or have a preserving effect. Different types of soils will also affect geophysical data collection and should be incorporated into the analysis of the data.

Landforms

The Red River's alluvial valley was formed during the Holocene and varies in width from 5 to 22 km in the Great Bend region (Pearson 1982). The single-channel Red River lies just east of Crenshaw and is separated from the site by a man made levee which follows the river's edge to the north and south. The alluvial valley is approximately 20 km wide near Crenshaw and narrows significantly as the river passes the site to the south. The alluvial valley is only 4 km wide on the east bank of the river while the western portion of the alluvial valley expands to 16 km. Beyond the alluvial valley lie terraces made during the Pleistocene, products of an ancient floodplain, and uplands created during the Tertiary (Pearson 1982). However, near Crenshaw there are no Pleistocene terraces and the alluvial valley gives way directly to the uplands.

Natural levees and backswamps line the river's meander belt. Most of the backswamp is on the western half of the alluvial valley, resulting in the disproportionate alluvial valley width west of the river (Guccione 2008). The alluvial valley has a low gradient of .1 to 1.1 m/km and has high local aggradation with small total aggradation (Guccione et al. 1998). The banks of the river are easily erodible resulting in constant and accelerated meandering. Oxbow lakes line the landscape in the alluvial valley as evidence of old meanders that resulted in fluvial landforms before being avulsed by the river channel. Determining the time these oxbow lakes and fluvial landforms were created is vital to understanding how the erosional and depositional processes of the river affected archaeological sites in the area, including complete destruction of large areas where sites likely existed in the past.

Figure 4.1 – Recent fluvial landforms. Blue areas are newer than about 400 B.P. (Pearson 1982). Red areas are newer than 50 B. P. The purple area has an unknown age, but is likely newer than 600 B.P.

Charles Pearson (1982) conducted a geomorphologic study of the Red River in the Great Bend region. He identified fluvial landforms that were younger than A.D. 1580 based on the location and fill of meander scars and an 1887 survey map (United States Engineer Department 1886-1892). The results have several important conclusions for the area around Crenshaw (Figure 4.1). The fluvial landforms between the current river and the First Old River and the Second Old River oxbow lakes, northwest and south of the site respectively, are likely newer than the site itself as First Old River formed between

1887 and 1912 and Second Old River formed between 1842 and 1864. This means that parts of Crenshaw may have been washed away by the river on the southern and northwest portions of the site and any satellite sites that may have existed in those areas also have been destroyed. Records support the age estimates of First Old River and Second Old River, as maps from 1842, 1864, 1887, 1912, 1929, and 1936 show (Figure 4.2). The Miller County line was surveyed in 1874 which can provide more information about the river's location at the time because it was situated near the site and was defined by the river's path (Guccione et al. 1998). In addition to maps, aerial photographs show the path of the river channel since the 1940s (Figure 4.3).

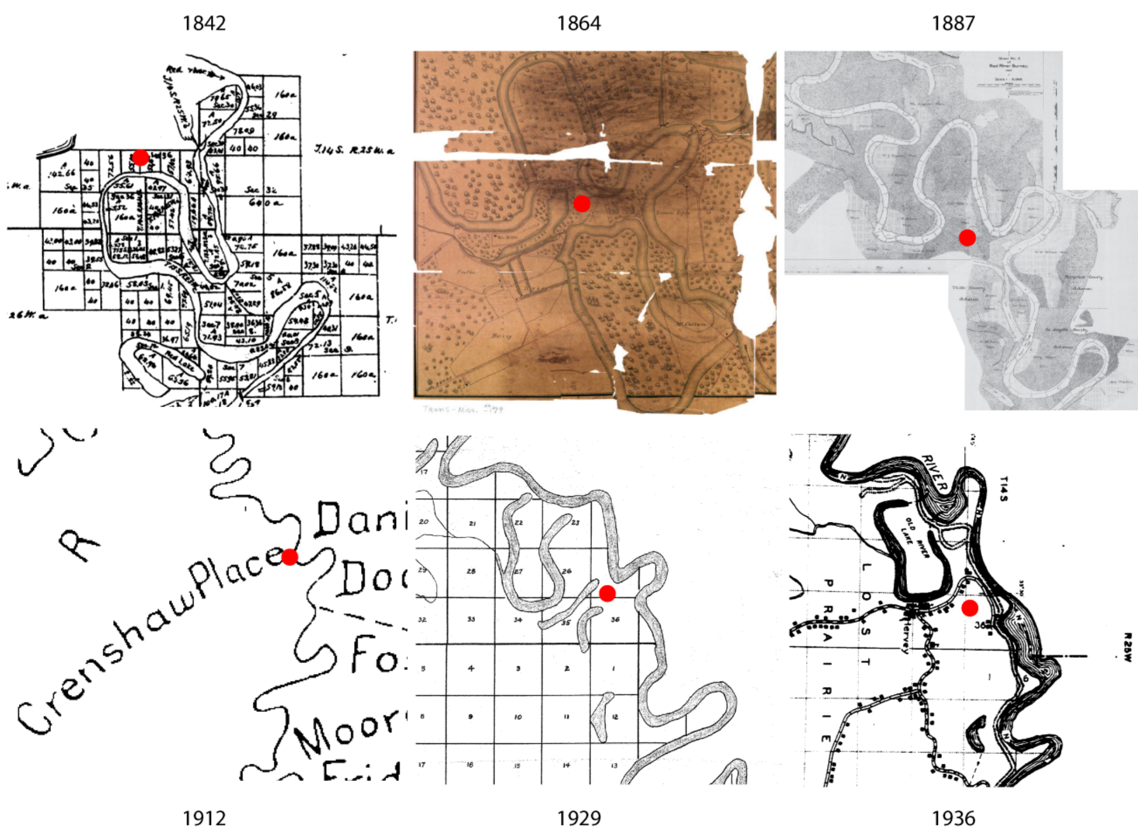

Figure 4.2 – Location of Red River around Crenshaw from 1842 to 1936 (Arkansas Commissioner of State Lands Office 2000; University of North Carolina Library 2009; United States Engineer Department 1886; Moore 1912; Arkansas Highway and Traffic Department [AHTD] 2009). Position of Crenshaw shown in red.

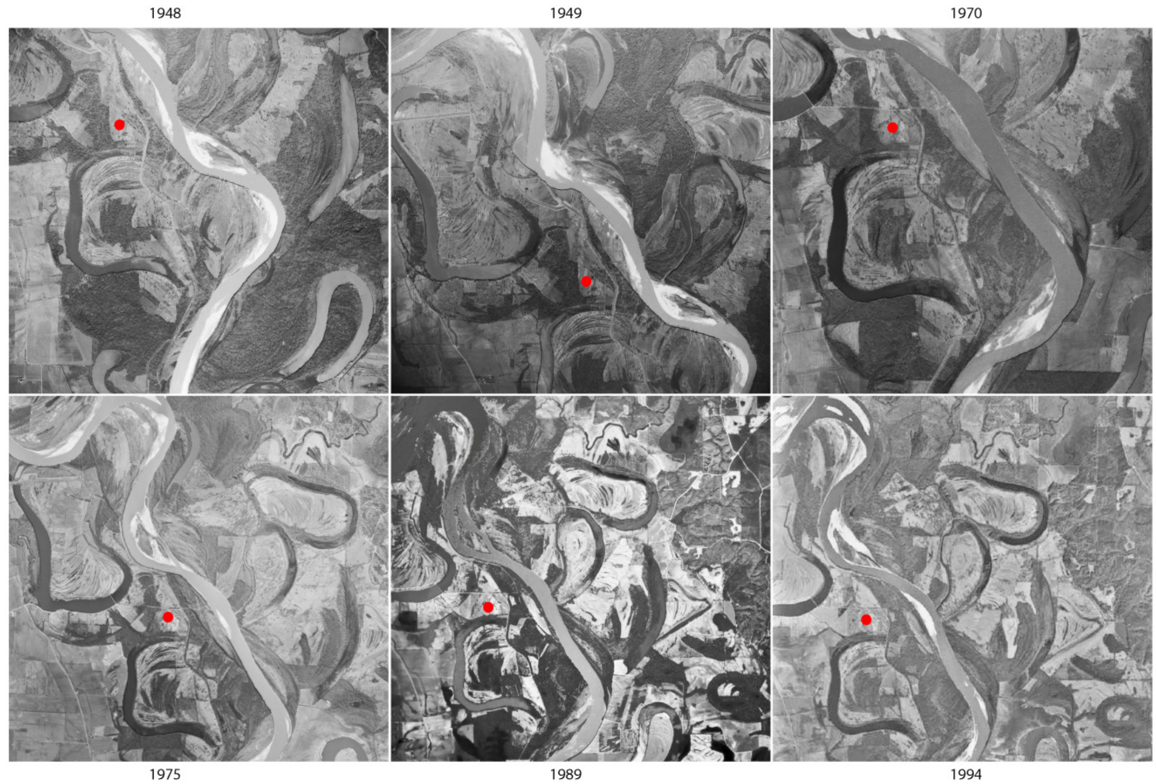

Figure 4.3 – USGS (2009) aerial photographs around Crenshaw from 1948 to 1994. Position of Crenshaw shown in red.

To the east of Crenshaw is the current river which has eroded the eastern part of the landform near Crenshaw as recently as the 1960's. On the east bank of the river, Pearson (1982) concluded that most of the alluvial valley east of the river near Crenshaw is young, precluding satellite sites from being found east of the river. However, there may be small portions that have been undisturbed as evidenced by 3HE12 and 3HE14, two mounds that may have Fourche Maline or Caddo cultural affiliations. Both of these sites lie in a thin sliver of land that appears to have avoided three separate meanders that approached it from the north, west, and south. Just east of these sites, the uplands begin. Unfortunately, the mound at 3HE14 was bulldozed into its own borrow pit. However, a portion of the mound may still be intact beneath the surface and may contain some remnants of the mound. On the east side of the Red River and to the north of Crenshaw, another prehistoric mound has been preserved (3HE17) that has an unknown cultural affiliation.

The area most likely to contain possible satellite sites of Crenshaw would be southwest and west of the site, beyond First Old River and Second Old River. There are already many prehistoric sites recorded in this area attesting to these landforms' older age. Some of these sites include preliminary designations as Fourche Maline or Caddo sites. The undisturbed area north of Crenshaw could also contain satellite sites, including a mound (3HE17).

The eastern edge of the site is unknown, but the river has left a fluvial landform just east of the site which will not contain any cultural material. The site continues to the north and the exact boundaries are also unknown. However, based on the records of the river channel's movements, it is unlikely anything will be found on the other side of the man made levee. The oxbow lake, First Old River, was avulsed by the river channel sometime between 1887 and 1912, incongruously, after Second Old River was avulsed around 1864. The meander that created First Old River destroyed any material to be found well to the northwest of the site, but the exact boundary of destruction is unknown. The western edge of the site is known to continue at least to the edge of the current fence posts where Fourche Maline material has been found. Based on the 1864 drawing, a lake had formed just west of the site. An AHTD (2009) map from 1929 also shows this lake. It may have formed in a depressed area left by an old oxbow lake, which would be prone to flooding. The landform near this area is likely newer than an occupation at Crenshaw, but its age is in question. This leaves a small thin area just southwest of the site that may still contain cultural material. This area might provide the opportunity to find the original extent of the site in that direction.

Soils

Crenshaw lies on a natural rise surrounded by the Red River and its former channels. Based on a soil survey (United States Department of Agriculture [USDA] 1984) of Lafayette, Little River, and Miller Counties, Crenshaw's soil is a Severn silt loam, gently undulating. This soil typically has a dark brown silt loam surface layer 13 cm thick overlaying about 1.9 m of stratified reddish brown or reddish yellow silt loam, fine sandy loam, and very fine sandy loam. This soil is appropriate for cultivated crops including soybeans, grain sorghum, and cotton and often does not have much organic content. However, Crenshaw likely has higher levels of organic content due to the deposition by the Fourche Maline and the Caddo people. The soil also makes the land capable of being used for pasture, hay, and woodland including pecan, cottonwood, sweetgum, and sycamore trees. Flooding occurs here rarely and the soil drains moderately rapidly. Moderately rapid draining can lead to dry and hard soil during dry seasons which is well known by previous excavators. The soil is moderately to mildly alkaline which suggests some other factor is responsible for the poor condition of many burials at Crenshaw, such as those that only contained the enamel of the teeth.

During dry seasons, the ground may be dry and hard, making resistance surveys difficult to perform as they require probes to be inserted into the ground with enough moisture to conduct an electrical current. Ground Penetrating Radar (GPR) may be well suited for this soil as there will be few natural factors such as rocks that will cause anomalies which by contrast can be difficult in areas with bedrock and rocks beneath the surface. The low clay content of the soil will result in low conductivity levels, especially when the soil is not wet. The low conductivity level of the soil will be beneficial for the GPR as high conductivity levels increase wave absorption which decreases the instrument's effectiveness (Conyers 2004). The soil will have low magnetism in areas without cultural debris due to the low organic content of the soil. Therefore, areas that contain cultural material which cause even low magnitude changes in magnetism should be detectable with a gradiometer.

Chapter 5: Methods

Finding Evidence of Settlement Patterns

Was the Crenshaw site a vacant mound center? Is there any evidence to suggest spatially discrete occupations? The most effective approach to answer these questions is an archaeogeophysical study of Crenshaw to determine the likelihood that structures or other features are present beneath the surface over a large area without disturbing or destroying a site. Archaeogeophysical surveys are uniquely equipped to provide primary source data on large areas with high spatial resolution. Studies of landscape archaeology are efficiently accomplished using archaeogeophysics as large area surveys can put features in context and allow for informed interpretations (Kvamme 2003). This kind of study may identify structures or other features based on their physical and chemical properties, which can be detected using archaeogeophysical techniques. Cultural affiliation may be suggested by comparing the properties of the anomalies with the properties of excavated cultural features from similar sites with a known cultural affiliation. Many studies have shown that this approach is applicable to Caddo archaeology (Walker and Perttula 2008). However, since Crenshaw is a multi-component site, the confidence in conclusions drawn about the cultural affiliation of features must await groundtruthing and further archaeological analysis.

Archaeogeophysics and Remote Sensing

Archaeologists are constantly searching for new ways to find and investigate archaeological sites. Borrowing from other fields, such as geology, archaeologists have discovered effective tools that aid them in their search for unknown archaeological sites and features. Geophysical techniques can detect changes in the earth's properties using a non-invasive set of tools. Resistance meters, magnetometers, electromagnetic (EM) induction meters, and Ground Penetrating Radar (GPR) are frequently used by archaeologists trying to answer questions about archaeological sites without destroying or disturbing the site itself. When these techniques are applied in an archaeological context, the term archaeogeophysics is used (Kvamme 2003).

Remote sensing is a broad term that includes archaeogeophysical techniques, but also includes some techniques used to study archaeological sites from a remote location. One such simple technique involves taking photographs of the ground from high altitudes. This technique has been used to discover new sites based on disproportionate vegetation growth and color change due to variable access to water or organically enriched soil as a result of human activities in the past.

As with aerial photography, all of these techniques are used in an effort to detect the traces of human activity by finding anomalies that can be explained by natural phenomena. For example, magnetometers detect changes in the magnetic field in the area of study. This includes the Earth's magnetic field and magnetic fields produced by soils, objects, and features. Unfortunately, it can often be difficult to determine which anomalies are due to human behavior and which anomalies are due to natural phenomena. However, archaeologists have made headway towards understanding the complex relationships between these natural phenomena, human behaviors, and the signatures the instruments detect. Using the technical theories behind archaeogeophysics, only logical interpretations should be made (Gaffney and Gater 2003). This can only be done once the theory of each technique is studied.

Archaeogeophysical techniques can be broken down into those that are active and those that are passive. Active techniques, such as resistance, GPR, and EM, measure phenomena that are induced by the instruments themselves. Passive techniques, such as magnetometry, measure natural phenomena that already exist without needing to induce a phenomenon. Some instruments require contact with the ground while others may be held above the surface (Gaffney and Gater 2003). Resistance meters must be inserted into the ground to create a current. GPR must be in constant contact with the ground so that the waves will propagate into the soil. Magnetometers and EM meters can work above the ground, but EM meters are often kept as close to the ground as possible to maximize sensitivity to deeper anomalies and to maintain a constant level above the ground.

Resistance

A resistance meter is used to detect changes in electrical resistance in the soil (Figure 5.1). A current is supplied by two probes that are inserted into the ground. The current is converted from the battery's DC current into an AC current to prevent polarization of the probes, which can lead to loss of conductivity around the probes (Clark 2000). A second pair of probes is inserted into the ground to measure the change in potential difference, or voltage, between two points in the ground. Those measurements then allow the instrument to calculate the resistance of the soil beneath. The first version of this instrument to be used in archaeology was arranged in a Wenner array which places the current electrodes on either side of the potential difference electrodes with each electrode equidistant from the last (C_1-P_1-P_2-C_2). The current electrodes supply the current and then the other electrodes measure potential difference where one electrode's measurement is subtracted from the other and divided by the supplied current to arrive at a resistance measurement for that spot on the ground. This is a formula derived from Ohm's law (R=V/I). In modern resistance meters, the current is held constant so that the resistance can be measured by the change in volts between the two probes (V_{p1}-V_{p2}) divided by a constant current. Resistivity can be calculated from the resistance measurement and the separation of the probes. Resistivity is useful for comparing measurements between sites (Clark 2000; Gaffney and Gater 2003).

Figure 5.1 – Dr. Jami Lockhart taking resistance data at Crenshaw with a Geoscan RM15 (photo by Anthony Clay Newton).

A Twin array is commonly used by archaeologists because it offers many advantages over the Wenner array. In this array, two electrodes, one current electrode and one potential difference electrode, are positioned in a fixed spot. The two other electrodes are mounted together on a mobile rack (C_1-P_1←large→C_2-P_2). In order to minimize errors due to probe proximity, the separation of the fixed probes should be .5 to 4.0 times the separation between the mobile probes. Also, the distance between the fixed probes and the mobile probes should be at least 30 times the separation of the mobile probes. At these distances, the error due to probe proximity has been shown to be less than three percent (Aspinall and Lynam 1970:72). The maximum depth is dependent on the properties of the soil, but is estimated to be between 1.0 and 1.5 times the probe separation, or .5 to .75 m with a probe separation of .5 m. One benefit is that the spatial resolution increases with the twin array, where a probe separation of .5 m provides a .5 m resolution. Wenner arrays can result in a single anomaly having multiple peaks, making interpretation more difficult. This does not happen when using a Twin array. One drawback of the Twin array is that anomalies tend to have a weaker signal compared to the Wenner array (Gaffney and Gater 2003).

Features beneath the soil that are either more or less resistant than the surrounding soil will cause anomalies to appear in the data. Anomalies that typically cause high resistance values include roads, stone coffins, rubble, walls, and built up earth. Anomalies that typically cause low resistance values include drains, graves, ditches, pits, and metal pipes (Gaffney and Gater 2003). These types of anomalies can affect several different natural processes. The properties of the soil, such as salt composition, can make the soils more or less resistive. Salt particles break down in water, forming ions that can transmit a current, increasing the conductivity of the soil (Clark 2000). Metal pipes, such as copper, are good conductors and provide a conductive path for a current. The presence of a metal pipe reduces the overall resistivity of the sample and causes a low resistance anomaly. Drains, graves, ditches, and pits can collect large amounts of water which increases the conductivity of the soil.

Changes in the water saturation of the soil can cause strong changes in a resistance survey. Depending on the level of precipitation, some anomalies can be represented by high resistance readings during dry months and low resistance readings during wet months. This means that some ditches can actually be high resistance anomalies during a drought, as the water collects at the bottom of the ditch where roots cannot reach. The soil around the ditch may distribute water evenly when compared to the ditch itself, leaving strong negative crop marks on the surface that are visible in aerial photography. The process of evaporation and vegetation take up of water is called evapotranspiration (Clark 2000). Consequently, not just rainfall and evaporation, but the presence of vegetation, can affect the level of water saturation in the soil. Therefore, vegetation can also cause anomalies. High resistance anomalies are common around trees as they soak up water around them and mask anomalies that might otherwise be represented by low resistance. However, tree canopies can decrease the sun’s ability to evaporate water, allowing more water to soak into the ground which causes low resistance anomalies around the outer edges of the trees.

Conducting a resistance survey at Crenshaw has to contend with the present circumstances of the site. It is currently being used as a pecan orchard with several mature trees and many trees just over 20 years old. Mature pecan trees can use 150 to 250 gallons of water on the hottest day of the year (Sammis and Herrera 1999). The soil at Crenshaw is a Severn silt loam which drains moderately rapidly, but it also has a high water capacity. It contains a maximum of two percent calcium carbonate, which is a salt that can be dissolved by water and increase conductivity (USDA 1984). The trees are spaced about 15 to 20 m apart in mostly irregular rows. The grass is allowed to grow very high which decreases the effects of evaporation in the soil, creating a moist ground. After the grass is cut, the ground surface quickly dries out, creating a hard, thick surface layer with moist subsoil. If conditions stay dry, the ground becomes very dry and very hard deep below the surface. This very dry, hard ground was encountered by Frank Schambach during his excavations at Crenshaw during the fall of 1969. As he was excavating the antler temple, he had to irrigate the test units in order to move any soil (Schambach 1969). If the soil is too hard, getting the instrument's probes through the surface layer may become difficult, but as long as there is still some moisture beneath the hard surface and the probes are able to penetrate the surface, it should still give adequate resistance readings.

Magnetometry

Magnetometry has become the workhorse of archaeogeophysics because of its many beneficial features. Surveys are fast with resolutions below one meter and can cover large areas (Kvamme 2006). A magnetometer is used to detect small changes in the magnetic field above ground. Several different types of magnetometers exist including proton, alkaline vapor, and fluxgate magnetometers. Proton magnetometers were the first developed for use in archaeology. They have many advantages, as they are high in precision (.1 nT), don't require calibration, don't have direction sensitivity, and require no set up. However, they are very slow during data collection (Clark 2000). Alkaline vapor magnetometers commonly use a cesium vapor and can achieve sensitivity in the picoTesla range (1 pT = .001 nT) (Gaffney and Gater 2003). They also collect data quickly, taking one measurement every .1 s. However, they are expensive and can be more likely to break (Clark 2000). Fluxgate magnetometers are the most commonly used in archaeology as they are fast and less expensive than cesium magnetometers. However, their sensitivity is only about .1 nT. They also can suffer from heading and drift issues, but have been developed to the point to where these problems have been minimized (Clark 2000). They still need to be calibrated before use to insure that they are not directionally sensitive and may need to be calibrated more than once a day to prevent drift.

Figure 5.2 – John Samuelsen taking gradiometry at Crenshaw with a Bartington Grad601-2 dual gradiometer (photo by Anthony Clay Newton).

Since magnetometers measure the magnetic field at a point, they are affected by anything that creates a magnetic field in the vicinity, including the Earth itself. The Earth's magnetic field is very large in comparison with the magnetic field created by even a very high magnetic anomaly (Clark 2000:65). This can make detecting anomalies difficult for magnetometers with the large noise that can be associated with the Earth's magnetic field. To counter this effect, gradiometers are used (Figure 5.2). Gradiometers contain two sensors separated vertically in a rigid system. The upper sensor, being further from the ground and any potential anomalies, detects the Earth's magnetic field and subtracts that from the measurement obtained by the lower sensor. This allows a gradiometer to record only the magnetic field of the materials in the immediate vicinity of the instrument.

Two phenomena affect the magnetic field of the soil, thermoremanence and magnetic susceptibility. Both of these phenomena rely on iron oxides in the soil. If the soil contains only low levels of iron oxides, there is only a small potential for the soil to become magnetized. Thermoremanence describes iron oxides in the soil becoming magnetically aligned with the Earth's magnetic field when they reach the Curie point, approximately 600° C. This is called remanent magnetism as materials are permanently altered and retain the magnetism after the phenomenon responsible for the change is no longer present (Kvamme 2006). At that point, the iron oxides lose their previous alignment and align with the Earth's magnetic field. Once they cool to below the Curie point, the new alignment is locked in and the iron oxides begin to produce a magnetic field based along the direction of the realignment. Therefore, areas of soil or other materials with iron oxides that have been burned beyond the Curie point in the past will leave a magnetic signature that is detectable by magnetometers. However, surveying in areas with igneous rocks, which also have been through a similar process, can be difficult (Gaffney and Gater 2003).

Magnetic susceptibility describes the ability of iron oxides to become magnetized when a magnetic field is applied to that material. This is called induced magnetism because it relies on an outside source to stimulate the material's reaction (Kvamme 2006). Since the Earth's magnetic field is always present, a magnetometer can detect materials that are magnetically susceptible. An EM detects materials that are magnetically susceptible more directly by inducing a magnetic field which causes the materials to become more magnetized (Gaffney and Gater 2003). Increased magnetic susceptibility is linked to the amount of hematite, magnetite, and maghemite in the soil. Hematite can be reduced by burning, turning it into magnetite. Magnetite can be further changed by being oxidized into maghemite while it cools. Hematite is low in magnetically susceptibility, but magnetite and maghemite are high, with the latter being the most magnetically susceptible. Hematite can also be changed by a fermentation process which causes the mineral to become maghemite after alternating periods of dry and wet soil. This process can contribute to top soils becoming more magnetically susceptible since they are more exposed to the elements than the subsoil (Kvamme 2006:208). The magnetism of the top soil can also be increased by microscopic bacteria which concentrates the iron oxides in the soil (Fassbinder et al. 1990).

Kvamme (2006) has noted seven ways that human behavior can create magnetic anomalies in the soil. First, humans build fires which can cause an increase in thermoremanence when iron oxides reach the Curie point. The magnetic susceptibility of the soil can also increase when an iron oxide has been burned at low temperatures. Soils show a strong increase when they have been burned above 300° C, especially clay (Lindford and Canti 2001:224). Second, remains of constructions can contain magnetic materials including fired daub, commonly found in Late Caddo houses which have been identified by strong magnetic anomalies (Lockhart 2007). Third, human activities enrich the top soil, such as the creation of fires and activities that increase the organic content of the soil, all of which can cause positive magnetic anomalies. Fourth, people build constructions that accrue top soil, like mounds, causeways, or houses, which creates anomalies with high magnetism. However, constructions can also remove top soil, indicating a fifth way. Ditches, roads, and pits are good examples that can cause anomalies with low magnetic signatures. The sixth and seventh ways are not likely to be found at prehistoric sites like Crenshaw because they are caused by iron artifacts or importing magnetic artifacts.

Even if magnetic features exist, there is no guarantee that they will be detectable by a magnetic survey. If a magnetic feature exists too far beneath the surface and is not strong enough, it may be missed. Magnetic features are not likely to be found if they exist deeper than one to two meters beneath the surface due to the quick reduction of a magnetic field through space (Kvamme 2006:222). Features that are too small are unlikely to be picked up since instruments have a finite sampling density. Another limitation due to the instrument is the level of sensitivity. Since anomalies are found by the contrast they display between themselves and the surrounding soil, if the contrast is less than the instrument's sensitivity, it will not be found. Of course, the quality of the data collection is also important as a badly calibrated instrument, an operator wearing metal, or an operator that has an uneven gait can decrease the ability for anomalies to be found. Anomalies that conform to regular geometric patterns, such as straight lines, circles, and rectangles, are also more likely to be recognized and are usually caused by human activities (Kvamme 2006).

Historic occupations at Crenshaw may have modified the landscape and deposited some metallic objects. These occupations may have created magnetic anomalies if they erected buildings or created fires on the landscape. Understanding where historic occupations may have created these anomalies is important as it prevents incorrect interpretations of historic activities as prehistoric activities. Areas with large amounts of metal can cause havoc on the data for a prehistoric site, masking any lower amplitude anomalies. However, finding large metallic anomalies is actually a desirable affect for historic sites (Bevan 1998:20).

Magnetometry is an excellent tool for determining if Crenshaw was a vacant mound center since it can be used for an investigation of landscape archaeology (Kvamme 2003, 2006). It is fast, can cover large areas, has high sensitivity, and can offer high spatial resolution data sets allowing for well delineated anomalies over large areas of a site.

Ground Penetrating Radar

GPR is typically slower than magnetometry and is not usually used for large area surveys, but can be a very effective tool for finding features beneath the surface in targeted areas. A GPR survey consists of pulling an antenna across the surface as it sends VHF radio pulses down into the ground (Figure 5.3). As the electromagnetic pulses travel downward, energy is reflected when materials change chemical or physical properties. If archaeological features have different properties than the surrounding soil, then they will also cause reflections. Those reflections and the amount of time it takes for them to return to the antenna are measured and recorded. The amount of time it takes for a pulse to return to the antenna is measured to determine the depth of the material that caused the reflection. The pulses may also be attenuated, conducted, or absorbed as they come in contact with different materials and soils. Wet clays can attenuate the signal, limiting the depth to which anomalies can be detected while dry sandy areas are generally considered good places for using GPR (Conyers 2004; Gaffney and Gater 2003).

Figure 5.3 – Dr. Jami Lockhart operating a GSSI SIR-3000 GPR with a 400MHz antenna mounted on a survey cart at Royston House in Old Washington, Arkansas (photo by Anthony Clay Newton).

The type of antenna used is the largest factor in determining how deep the GPR can penetrate into the soil. The lower the frequency an antenna uses, the deeper it will be able to penetrate, but it will be less likely to detect smaller objects (Conyers 2004). Antennas used in archaeology can have center frequencies between 80 MHz and 1 GHz. However, the most common antennas used have center frequencies around 200 to 500 MHz (Gaffney and Gater 2003). A 400 MHz antenna is a good compromise that can penetrate about two meters into the ground in favorable conditions and can detect medium and large sized objects. With a center frequency of 400 MHz, such an antenna actually generates frequencies between about 200-800 MHz in a bell-shaped distribution with most of the energy centered on 400 MHz.

The dominant factor for the probability of a successful survey with GPR is the electrical properties of the soil (Gaffney and Gater 2003:49). If soils are highly conductive, then the pulses will not be able to propagate through the soil and will instead be conducted away. This is because a wave will stop propagating if either the electrical or magnetic portion of the electromagnetic wave is lost (Conyers 2004). Therefore, sites that have higher resistivity values are more likely to be good candidates for GPR surveys.

The speed at which an electromagnetic wave passes through a material is affected by that material's relative dielectric permittivity (RDP). The RDP refers to that material's ability to store and then transmit electromagnetic energy. This value can be important for proper instrument calibration (Conyers 2004). Reflections are caused by changes in RDP as the waves travel downward through the soil. This can cause reflections at strata interfaces and in places where archaeological materials contrast with the surrounding soil. The larger the change in RDP between materials, the greater the reflection produced

(Gaffney and Gater 2003:50). One method to determine a material's RDP is to find a hyperbola in the data and analyze its properties. A hyperbola is caused by a point feature beneath the surface (Conyers 2004). The antenna sends pulses in a cone that spreads as it descends, causing reflections to be returned to the antenna that are from a feature ahead of or behind the antenna. As the antenna approaches the feature, the feature appears to be deeper than it is and as if it is directly below the antenna. When the antenna is actually directly over the feature, it appears at its correct depth. As the antenna moves beyond the feature, it still appears to be directly below the antenna and deeper than it is. The way this hyperbola is recorded is directly related to the RDP of the soil surrounding the feature.

The Severn silt loam soil at Crenshaw has a fairly low concentration of clay, about 20%, with the rest of the soil being made up of sand and silt, with a higher concentration of the latter (USDA 1984). This may result in good GPR results in most conditions as the low clay concentration should not greatly attenuate the signal. Conductivity of this soil may be moderate if it is very wet, but should be low otherwise.

Electromagnetic Induction

EM meters detect two types of natural phenomena, conductivity and magnetic susceptibility using quadrature and in-phase modes respectively, which can be collected simultaneously with some instruments (Figure 5.4). An EM meter has two coils, one that creates an alternating magnetic field, creating a current in the soil which then causes the soil to produce another magnetic field based on the properties of the soil (Gaffney and Gater 2003). The other coil measures this response from the soil below. The magnitude of the magnetic field is proportional to the magnetic susceptibility of the soil while the rate of change of the magnetic field is proportional to the conductivity (Gaffney and Gater 2003).

Figure 5.4 – Geonics EM38B electromagnetic induction meter.

Conductivity is the inverse of resistivity and should theoretically show similar anomalies when compared to the resistance of the same area. However, conductivity can show very different results from resistance in practice. There are cases where a conductivity survey is more useful. If a resistance meter is unable to complete a circuit in the soil because the soil has very high resistivity or the ground surface is too hard to penetrate with probes, an EM would provide a good alternative for data collection as it does not need to penetrate or touch the surface to collect conductivity data. Magnetic susceptibility has been covered in depth in the magnetometry and GPR sections as it affects all of these instruments. However, unlike the other two tools, the EM detects magnetic susceptibility directly and can provide more information about detected anomalies.

The EM is a moderately slow instrument compared to magnetometry and resistance in most cases. However, with an automatic data logger, the instrument can collect data relatively quickly. At Crenshaw it is expected to be fairly useful for finding areas of enhanced magnetic susceptibility, but it may be better used in a small area survey after anomalies have already been found using other technologies. However, testing the instrument at the site is a good idea to determine how effective an EM survey is at finding anomalies.

Aerial Photography

Aerial photography allows archaeologists to see sites from a different vantage point as they can provide a larger scale view of the landscape. This can highlight parts of a site that have been overlooked in the past and help determine which parts of a site would benefit from further research. Aerial photography can be used to search for new site locations where large anomalies appear in the photographs (Figure 5.5). They can also be used on an intra-site level to find anomalies that may be hard to see at ground level. Anomalies can be difficult to see at ground level because of the near parallel angle at which they are viewed or because they are too large to be noticed. Once an aerial photograph is taken, it provides a permanent record of the site at that point in time (Giardino and Haley 2006). Different aerial photographs from different time periods or from different seasons can be used to compare the changes at a site and can document important events.

Figure 5.5 – Aerial photograph showing an old road's path next to the current highway near Crenshaw.

It can be easier to identify patterns in black and white photographs when compared to color photographs, but color infrared photographs can supply extra information by including the near infrared color spectrum which is sensitive to changes in vegetation moisture and health. Anomalies are typically found because of crop marks, soil marks, snow marks, or shadow marks (Giardino and Haley 2006). Soil marks may appear because human occupations can change the soil color and add organic material to the soil in specific locations. Crop marks can also be affected by human occupations. Ditches, pits, earth mounding, and midden areas can enhance or decrease the vibrancy of grass or crops.

Research Plan

The archaeogeophysical survey of Crenshaw was broken into two four day sessions. The first session included setting up survey grids sized 20 x 20 m over a large portion of the southern edge of the site. The southern part of the site, confined to Mr. and Mrs. Head's property, was selected because it has had relatively little disturbance, being away from the mounds and located on property that has been protected from looters by the land owners. This area was also not extensively cultivated or used by historic land owners as far as it is known (see Chapter 3). Therefore, any anomalies found would have a higher probability of having prehistoric origins.

Researchers in the past often started at the mounds and worked their way out, creating a large gap in information about the extremities of a site. At Crenshaw, much is known about the mounds and some is known about their immediate vicinities, but little is known about the areas away from the mounds. By starting at the southern edge and working back towards the mounds, much could be discovered about an area that has not yet been investigated. This area was also selected because of the proximity to the only known structure at the site, the antler temple. The antler temple is located about 30 m east of this first session's study area, across the fence line separating Mr. and Mrs. Head's property from the Rayburn family's property. The location of the West Skull Area, which has its western border on the Rayburn's side of the fence line, was an additional reason to survey this area, as its western boarder was not defined during excavation because the excavation stopped at the fence line.

The southern area near the West Skull Area, hereafter referred to as Section 1 (Figure 5.6), was to be surveyed with a gradiometer and a resistance meter in an attempt to find any anomalies that might suggest the presence of a structure. These instruments can produce anomalies indicative of pits, which could indicate a continuation of the West Skull Area. In addition, a small survey using the GPR and EM was to be conducted to test the instruments' capabilities at the site. Section 1 is a relatively low to moderate elevation area with a very slight slope to the southwest. However, the area is very flat and the slope is not noticeable when at the location. It is 80 m east/west x 60 m north/south which is made up of twelve 20 x 20 m grids. All 12 grids were surveyed with a gradiometer and a resistance meter. A 10 x 60 m area was sampled with GPR and four grids were sampled with an EM.

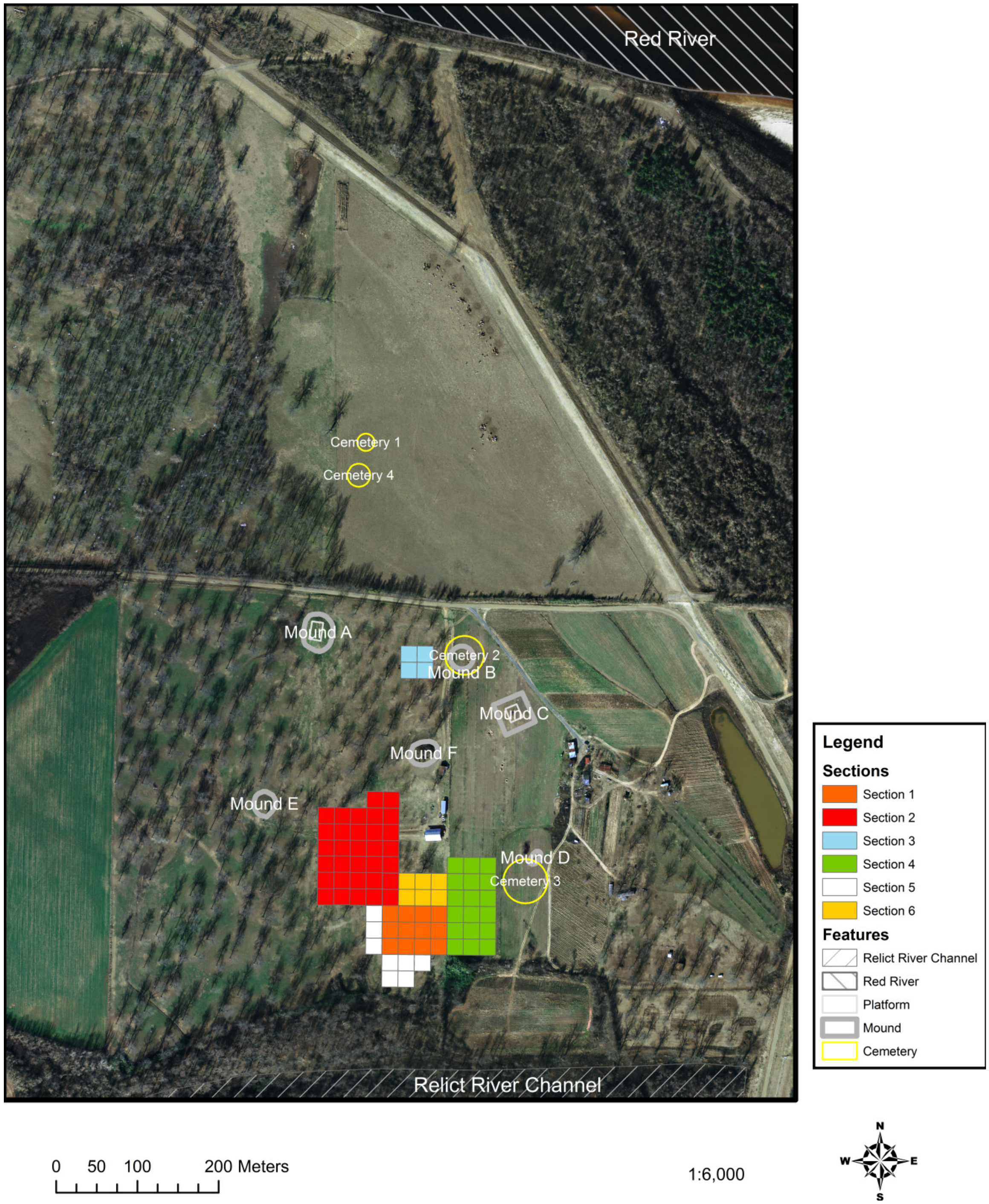

Figure 5.6 – The Crenshaw site with Sections 1 through 6. The background aerial photograph is from 2006.

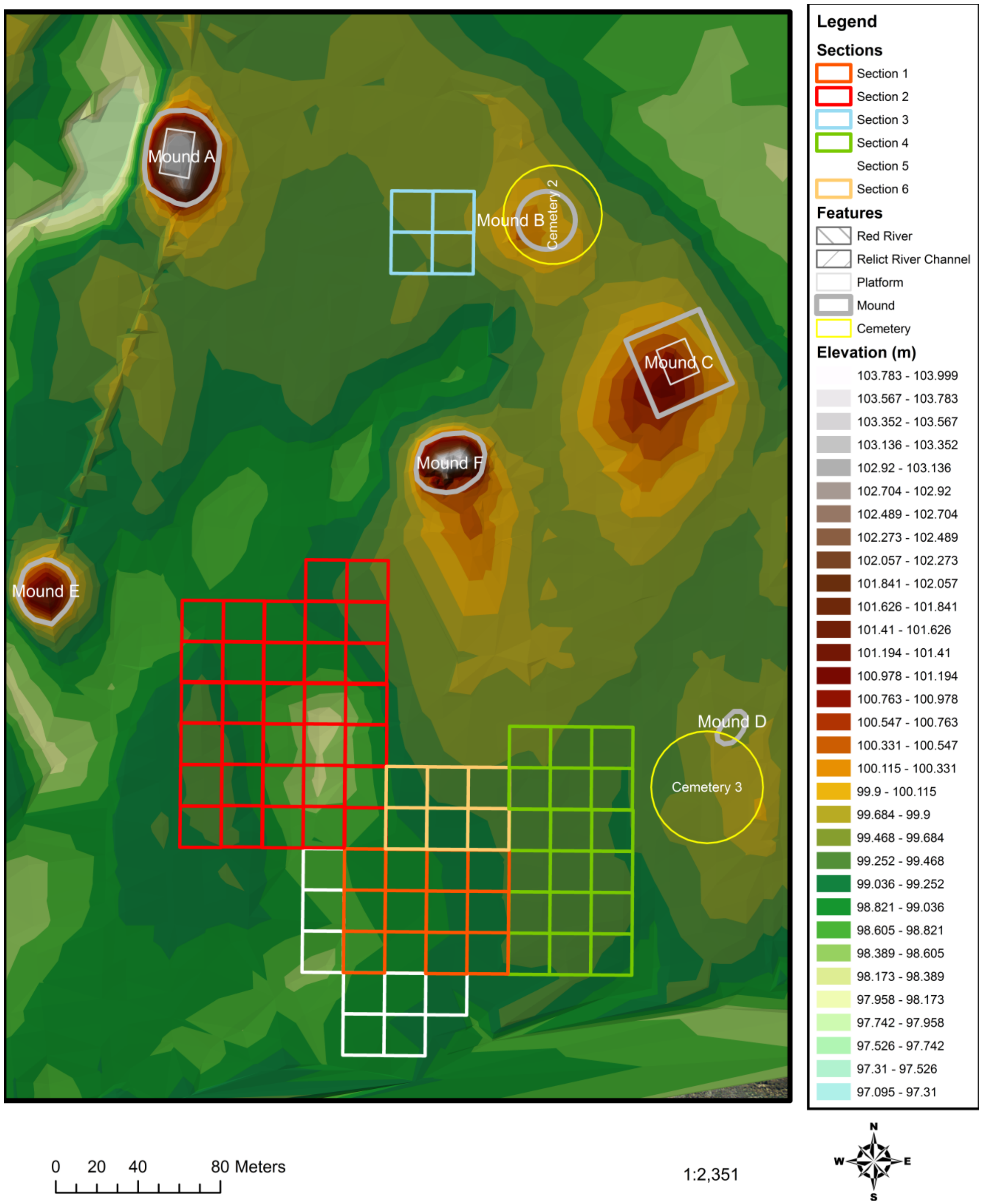

Figure 5.7 – Sections 1 through 6 with topographic map.

A large area on the south part of Mr. and Mrs. Head's property was also included in the first session, located south of and between Mound E and Mound F, hereafter referred to as Section 2. Some flakes had been found in this area, lending support for human activity, but no other information is known. A topographic map of this area shows that it is made up of a relatively moderate elevation ridge and a relatively low swale (Figure 5.7). The entire area was surveyed with a gradiometer taking thirty-two 20 x 20 m grids. An additional 10 grids were taken on the west and northwest edges of Section 2, but were unfortunately lost due to download compatibility issues with Windows Vista. Five grids, three grids along the southeastern edge of Section 2 and two grids along the northwestern edge of Section 1, were lost due to the same issue. However, these five grids were previously taken at one meter transect spacing which is lower resolution than the .5 m spacing used elsewhere.

After the first session was complete, more information was collected about the site including aerial photographs. There are many aerial photographs of the region around Crenshaw from the past 60 years, most of which are black and white and have low definition. However, high resolution aerial photography of the site was ordered in 1969 by Dr. R. K. Harrison and the negatives were donated to the Arkansas Archeological Survey. These photographs have been seen by archaeologists before, but were not analyzed. It was discovered that the aerial photograph from April 1969 showed a mysterious anomaly about 40 to 60 m west of Mound B, far north of the previous survey area (Figure 5.8). It was circular in shape, about 12 m in diameter with another, lighter circle centered inside of it (Figure 5.9). This information suggested that a second session was necessary to determine if this anomaly could be verified with archaeogeophysics and would be a good candidate for multiple technologies. The oblique aerial photograph had to be overlaid on the current surface in ArcMap to estimate its current position. A four grid area was mapped out for inclusion in the next four day session to insure that the anomaly would be contained within the survey area.

Figure 5.8 – 1969 aerial photograph of the Crenshaw site, looking southeast.

Figure 5.9 – Close up view of double circular anomaly from 1969 aerial photograph with high contrast.

The Rayburn family gave permission for a survey of an area east of Section 1, which allowed for the inclusion of the antler temple and the West Skull Area in the study area. Once permission was granted, it was a good opportunity to test if any structures or other features could be found east and north of the antler temple. An area south and west of Section 1 was included to attempt to find the end of an anomaly detected in Section 1. Another area north of Section 1 was included to link Sections 1, 2, and 4 together.

The four grid area 40 to 60 m west of Mound B, hereafter referred to as Section 3, was surveyed with a gradiometer and GPR. One grid in the northeast corner was also surveyed with resistance. The other three grids were not surveyed with resistance due to a combination of factors including instrument malfunction. The area located on the Rayburn family's property, hereafter referred to as Section 4, was surveyed with 18 grids of gradiometry. Section 4 was 60 m east/west x 120 m north/south and contained the

North and West Skull Areas and the antler temple. It also contained a large area east and north of the antler temple. Also of interest was the possibility of finding pits in the areas around the North and West Skull Areas, so two and a half grids of resistance were taken in Section 4 before part of the resistance meter broke, disabling more data collection. The areas south and west of Section 1, hereafter referred to as Section 5, was surveyed with eight grids of gradiometry and the area north of Section 1, hereafter referred to as Section 6, was surveyed with six grids of gradiometry.

Data Collection

A total of 104 twenty by twenty meter archaeogeophysical grids were collected at Crenshaw in eight days with a field crew of one to five people depending on the day. Eighty grids (3.2 hectares) of gradiometry were surveyed with a Bartington Grad601-2 dual gradiometer. Measurements were taken at .5 m transect spacing except for the five grids that were taken at one meter spacing. They were also taken with either four or eight measurements per meter along transects at 1.4 m/s. Sixteen resistance grids were taken with a Geoscan RM15 resistance meter with a MPX15 multiplexer using five remote probes so that four measurements were taken simultaneously. Transect spacing was .5 m with a .5 m spacing along each transect. Four GPR grids were taken with a GSSI SIR-3000 using a 400 MHz antenna and mounted on a survey cart. Transect spacing was .5 m with 50 scans/m along transects and 512 samples/scan. An additional 10 x 60 m area was also surveyed with GPR. Four EM grids were surveyed with a Geonics EM-38B which allows conductivity and magnetic susceptibility to be measured simultaneously. One grid with transect spacing of .5 m with .5 m spacing along each transect was collected. Three were collected at one meter transect spacing with .5 m spacing along each transect.

Data Processing

Magnetometry was processed using ArcheoSurveyor 2.0. Grids were adjusted for staggering and striping, although some grids needed less adjustment then others. Calibrating the instrument three times a day, once in the morning, once in mid-morning, and once after lunch, seemed to be the best strategy to keep striping and drift to manageable levels. Low pass and high pass filters were used and the data was clipped to highlight important anomalies in the data.

Resistance, conductivity, and magnetic susceptibility were processed with Geoplot 3.00 mx. Resistance grids were analyzed individually to maximize pattern recognition. The data was clipped and high pass and low pass filters were used. The resistance grids required multiple runs of despiking processes due to the large numbers of spikes in the data caused by instrument malfunction. Conductivity was also processed with high and low pass filters with clipping. Magnetic susceptibility required a zero mean transect process to correct for some striping in the data. It was then also processed using high and low pass filters with clipping. The GPR data was processed with GSSI's RADAN 6.5.3.0 program. Most grids required only a little processing. However, one grid required heavy background removal, a low pass filter, and a high pass filter. This was because the site was being baled for hay on the first and second days of data collection during the second four day session. The first grid that was collected with GPR still had rows of hay mounded in a north to south pattern. Theses hay piles caused voids between the surface and the antenna which resulted in high amplitude reflections to reverberate between the ground surface and the antenna, masking the deeper anomalies (Figure 5.10). These affects were processed out, but this may have also obscured some of the anomalies. As a result, the data was analyzed using both processed and unprocessed grids.

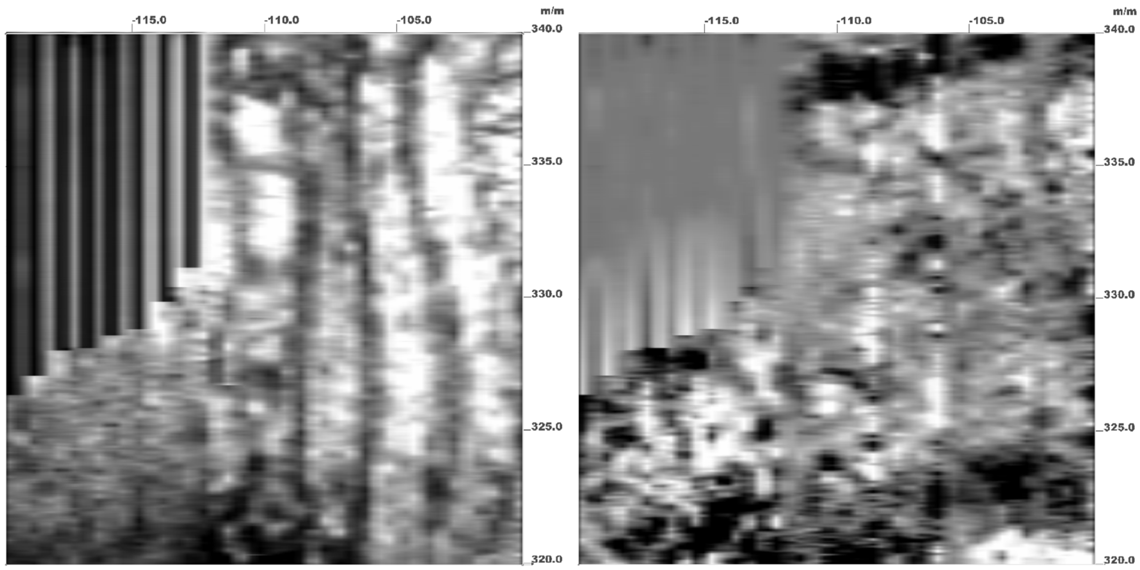

Figure 5.10 – GPR time slices without and with background removal and filters.

Use of Methods

The use of these archaeogeophysical techniques allowed for the discovery of many possible prehistoric structures. They also resulted in the discovery of areas which were in use during historic times. The success of the survey was due to the ability of the gradiometer to survey large areas rapidly without the need for excavation. The resistance, conductivity, magnetic susceptibility, and GPR provided support to the gradiometry by confirming anomalies and revealing anomalies not detected by the gradiometer.

Chapter 6: Results

Archaeogeophysical Results

The geophysical patterns and anomalies identified in the investigations offer demonstrable evidence of prehistoric activities and features at the Crenshaw site, particularly anomalies detected by the gradiometry. However, the scatter of historic metal and metal fences distorted the magnetic patterns in several areas, and concentrations of metal suggest that historic structures may be present within the collection grids. GPR proved to be useful in detecting anomalies with archaeological significance in some areas but not in others, while resistance identified possible structures that gradiometry did not detect. Conductivity and magnetic susceptibility surveys would have benefitted from increased resolution.

The site is organized into three areas based on the results and their differing topography. Areas A, B, and C (Figure 6.1) vary in size and the amount of data they produced (Figure 6.2). Area A is a small 40 x 40 m area just west of Mound B and was surveyed using four technologies: aerial photography, gradiometry, GPR, and resistance. Area A is a relatively high and flat topographic area (Figure 6.3). Areas B and C are located on the south central portion of the site. Area B is a large area of relatively high topography and small areas of low topography. It was surveyed with gradiometry, which produced many anomalies. Area C is a large area with relatively flat and low topography which is slightly sloping to the west-southwest. It was surveyed with gradiometry, resistance, conductivity, magnetic susceptibility, and GPR. The results are presented with groupings of anomalies based on their patterns and their possible interpretations.

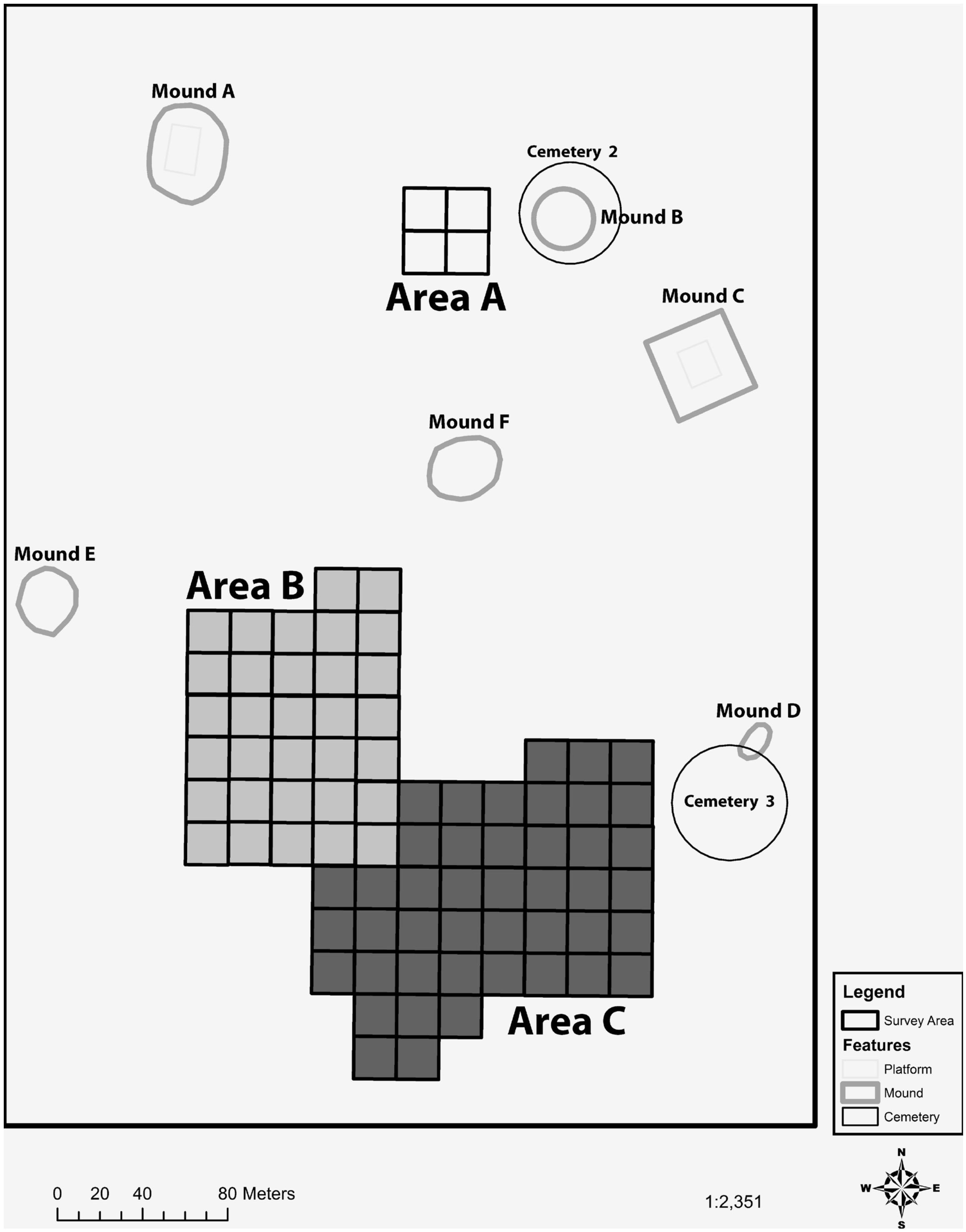

Figure 6.1 – The study area divided into Areas A, B, and C.

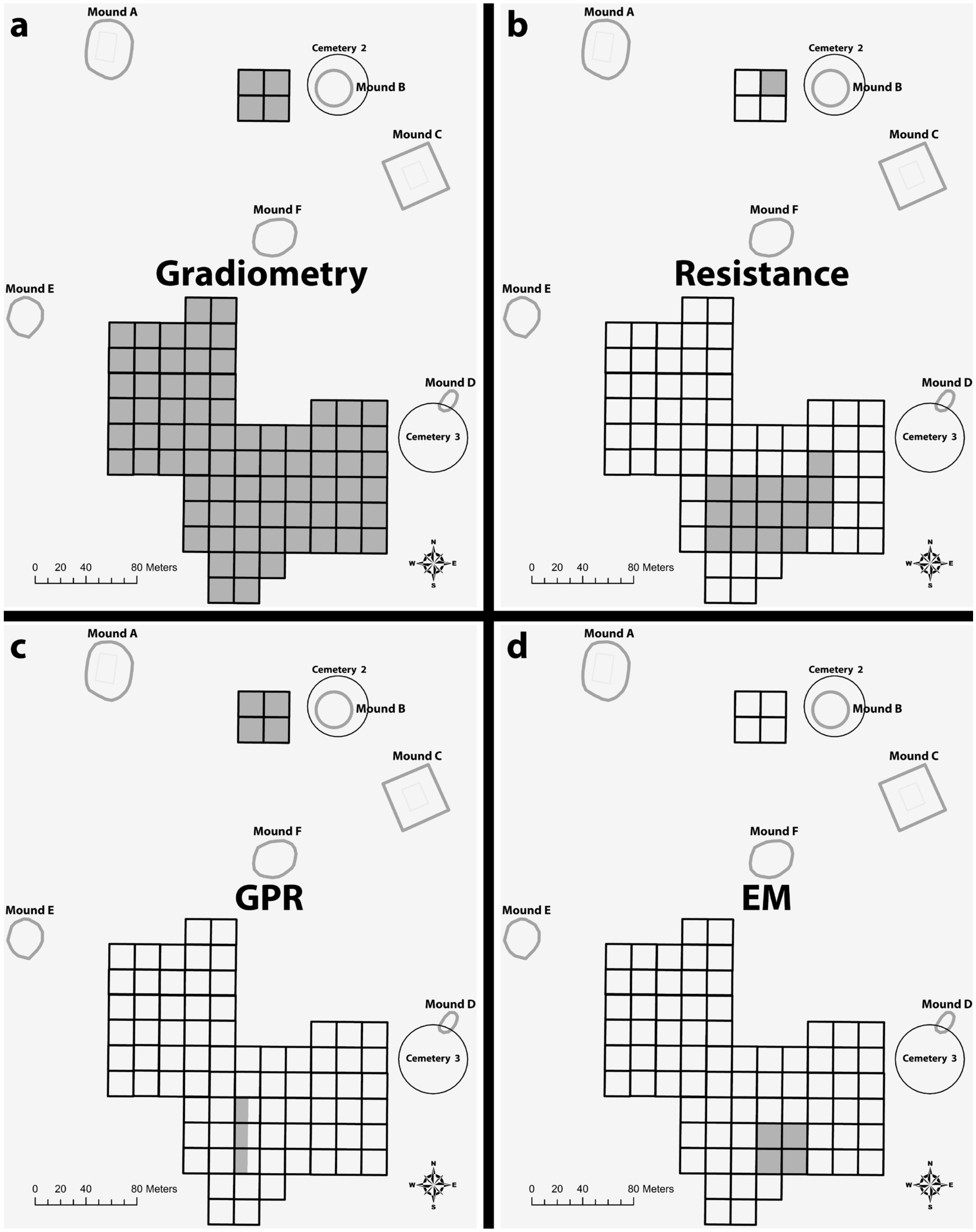

Figure 6.2 - Survey technologies: a) area surveyed with gradiometry; b) area surveyed with resistance; c) area surveyed with GPR; d) area surveyed with EM (conductivity and magnetic susceptibility).

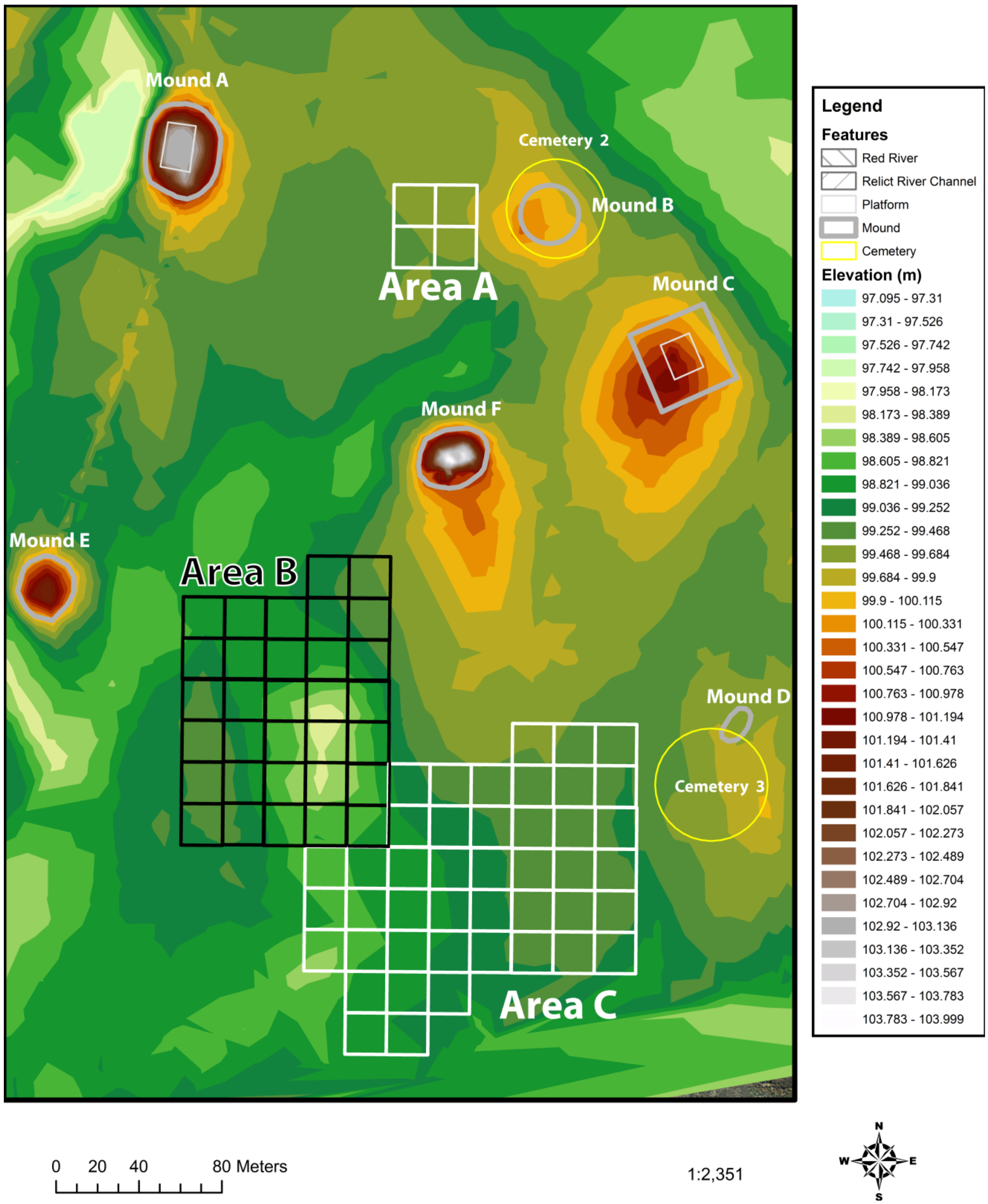

Figure 6.3 – The study area divided into Areas A, B, and C with topography.

Possible Structures

Area A

An aerial photograph taken in 1969 showed a 12 m diameter circular area of increased vegetation west of the estimated location of Mound B (Figure 6.4). The circular anomaly may have a smaller circular anomaly inside, appearing as a concentric circle pattern. This area was surveyed with gradiometry (Figure 6.5) and GPR, as well as a single resistance grid, to determine if this aerial photograph feature could be detected with ground-based archaeogeophysics. A close up of this anomaly and the area surrounding Area A was processed using Adobe Photoshop including a custom filter created to reduce the effect of the diagonal mowing marks (Figure 6.6:b). The contrast and brightness were also adjusted to highlight the anomalies. Analysis of this area for pattern recognition revealed numerous circular anomalies. Several rectangular, linear, and large anomalies also appeared. Since many factors, including cattle circles, could cause circular anomalies in the aerial photography, circular anomalies are not considered possible structures without ground based archaeogeophysical evidence to support that interpretation. More anomalies may be present in this area, but do not have an obvious pattern. Anomalies that intersected Area A and appear to continue outside were also incorporated into the analysis.

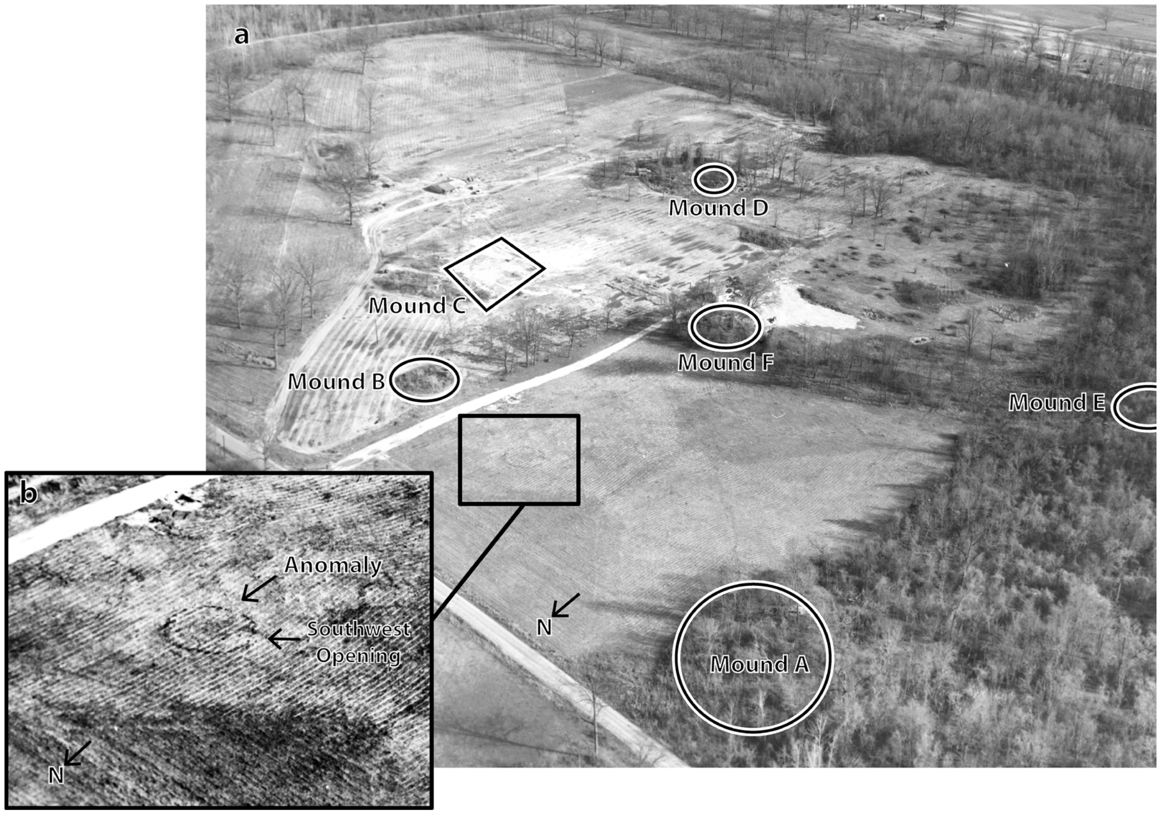

Figure 6.4 – Circular anomaly visible in 1969 aerial photograph: a, from low flying plane directed southeast (positions of Mound B, Mound C, and Mound D are estimated); b, Close-up of the circular anomaly with increased contrast. The anomaly appears to open on the southwest side.

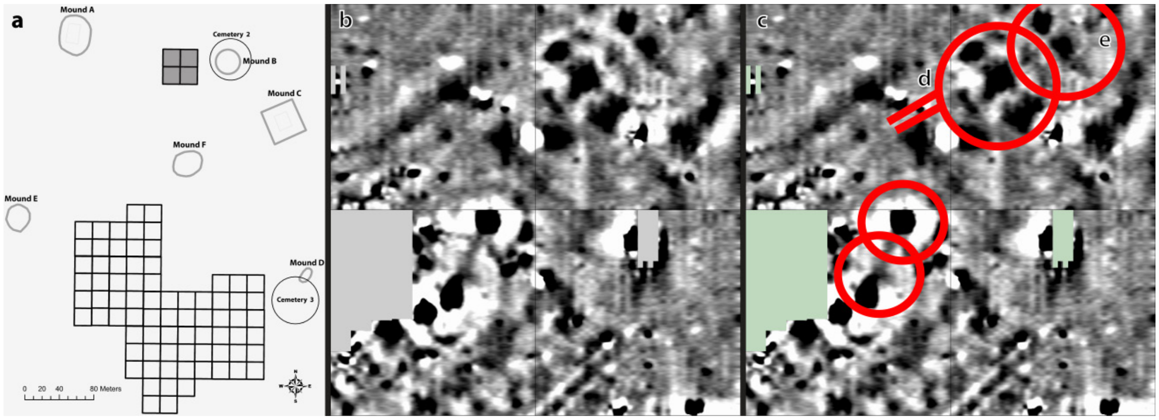

Figure 6.5 – Area A gradiometry: a, position on site; b, gradiometry results; c, gradiometry with possible structures marked (red); d, a possible structure with a possible extended entranceway leading southwest; e, a possible structure similar to and intersecting possible structure d. Areas without data were blocked by brush. Areas of increased magnetism are darker and areas of decreased magnetism are lighter. Values are clipped to ± 1 nT.

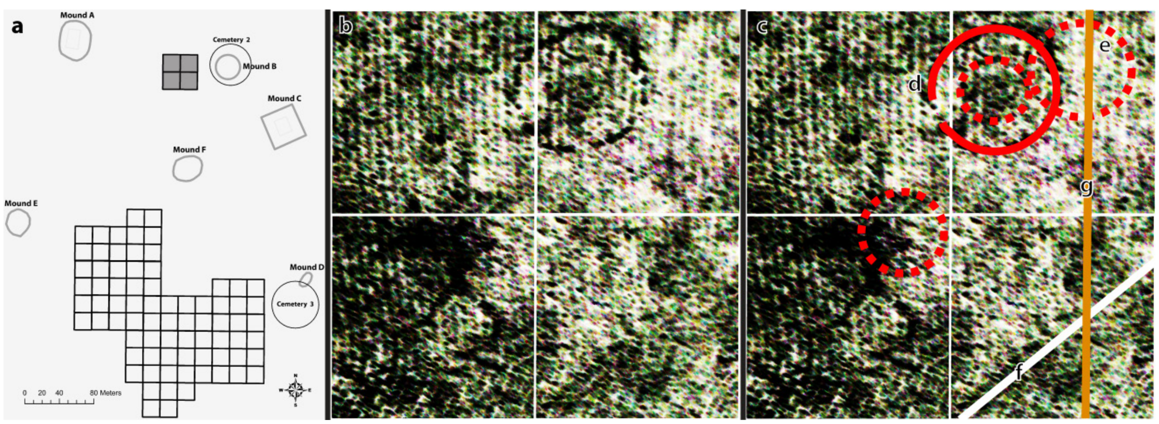

Figure 6.6 – Position corrected aerial photograph (estimated): a, position on site; b, aerial photograph; c, aerial photograph with possible structures marked (red); d, a possible structure which matches the anomaly in the gradiometry (Figure 6.5:d) defined by a strong pattern of increased vegetation vibrancy; e, a possible structure defined by a weak (dotted) circular pattern of decreased vegetation vibrancy, but matches the approximate position of an anomaly in the gradiometry (Figure 6.5:e); f, double line of increased vegetation vibrancy, likely due to wheel marks (also visible in gradiometry); g, line of increased vegetation vibrancy. Slight differences in anomaly positions can be explained by topographic changes which create distortions in oblique aerial photographs.

To compare datasets, the position of the anomalies in the oblique aerial photograph needed to be determined. The aerial photograph from 1969 was taken at an angle from a low flying airplane looking southeast. In order to overlay Area A and to identify the position of the circular anomaly on the modern landscape, buildings in the aerial photograph were compared to the shape and size of the anomaly. The dimensions of the buildings in the photograph were known as they are still in use. Those measurements could then be used to compare the size of the anomaly to the size of the buildings in the aerial photography, taking into account the anomaly's and buildings' distance from the camera. In this way, the major anomaly in the aerial photograph was estimated to be about 12 m in diameter. The distance from Mound B and a telephone pole was then used to triangulate the anomaly's approximate position within Area A. Once archaeogeophysical data was collected, the location of Area A was defined based on similar anomalies found in multiple datasets (Figure 6.6). The overlay of Area A also had to be corrected for change in topography. The lowering slope on the southern edge of Area A caused a distortion, but the diagonal mowing marks provided a baseline to determine the degree to which the overlay needed to be adjusted.

While the GPR and resistance did not produce any anomalies that could be attributed to the circular aerial photograph feature, the gradiometry displayed a circular anomaly 12 m in diameter (Figure 6.5:d; Figure 6.6:d) in that location along with three other possible structures. Two of these possible structures (Figure 6.5:d-e) spatially overlap and have very similar magnetic patterns in the data. However, one of these possible structures (Figure 6.5:d) has a slight linear pattern of decreased magnetism on the southwest side that may be indicative of an extended entranceway pointing to the southwest. The aerial photograph also shows that this possible structure had an area in its southwestern portion where the vegetation was less vibrant, suggesting that there may have been an opening in this area (Figure 6.6:d). Some Caddo structures in the southern

Caddo area have extended entranceways directed in a southwesterly direction (Perttula 2009:Table 5).

This possible structure also has much in common with several Caddo structures from other sites. The area of low magnetism that defines the circular outline of the possible structure may have been created from post holes that were filled with soil that was less magnetic than the surrounding soil. Alternatively, this possible structure may have had wall trenches as seen in Feature 9 from the George C. Davis site in East Texas, House 4 at the Belcher Mound site in northwestern Louisiana, and Feature 18 from the Standridge site (3MN53) in Montgomery County, Arkansas (Early 1988:Figure 23). House 4 (Figure 6.7) at the Belcher Mound was a rectangular house associated with the Haley phase with wall trenches that had posts inserted. It had an entranceway made with trenches with a small ash pile set in the middle. The house was mounded over and there were three burial pits intrusive into the house floor (Webb 1959). Several houses excavated at the George C. Davis site, Features 9, 43, and 45, were also made with trenches including a few that were sub-rectangular or circular in shape. Feature 9 (Figure 6.8) was sub-rectangular with a complete wall trench and a trenched extended entranceway. Features 43 and 45 were circular structures with only partial trenching along the walls (Newell and Krieger 1949). Trenches could cause water to collect at the bottom, allowing vegetation to draw more water and grow more vibrantly, resulting in crop marks such as those seen in the 1969 aerial photograph. However, the use of wall trenches in the southern Caddo area is very uncommon. This possible structure also has four smaller areas of decreased magnetism (between -1 and -2 nT in magnitude after a filter) surrounding the center of the possible structure that may mark interior support posts. This four post pattern is also commonly seen in archaeogeophysical results of possible structures at George C. Davis (Creel et al. 2005:Figure 3; Walker and Perttula 2008:Figure 7a).

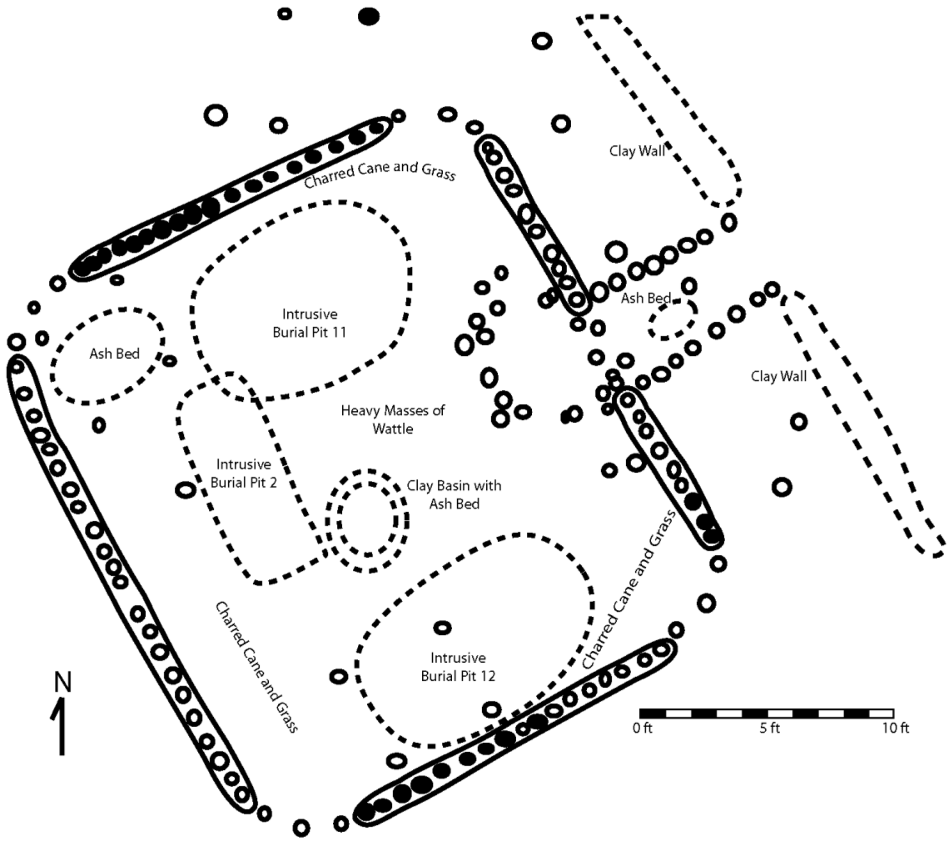

Figure 6.7 – House 4 at Belcher mound with trenched walls (after Webb 1959:Figure 23). Filled post holes are burnt.

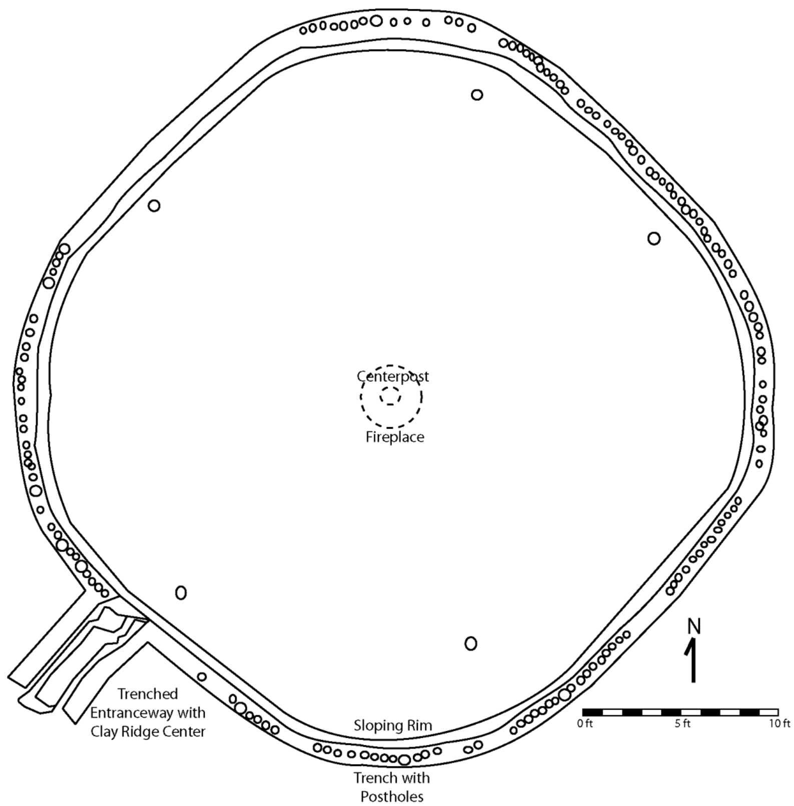

Figure 6.8 – Feature 9 at the George C. Davis site (after Newell and Krieger 1949:Figure 11).

The three areas of increased magnetism arranged in a northwest to southeast line in two of these possible structures (Figure 6.6:d-e) are comparable to Feature 33 at George C. Davis (Figure 6.9), in that it had three features within it that were aligned in a northwest to southeast pattern. Two of the features, including the center feature, were fireplaces, while the third was a pit filled with small bits of bone and some other materials. The three areas within these two possible structures at Crenshaw probably represent fireplaces and pits filled with culturally enriched materials that caused anomalies with increased magnetism. The area of high magnetism in the center of one of the possible structures (Figure 6.5:d) peaks at 5 nT. The two areas of high magnetism to the northwest and southeast of the center peak at 3 nT. The area of high magnetism in the center of the other possible structure (Figure 6.5:e) peaks at 2 nT while the area of high magnetism to the northwest peaks at 3.5 nT.

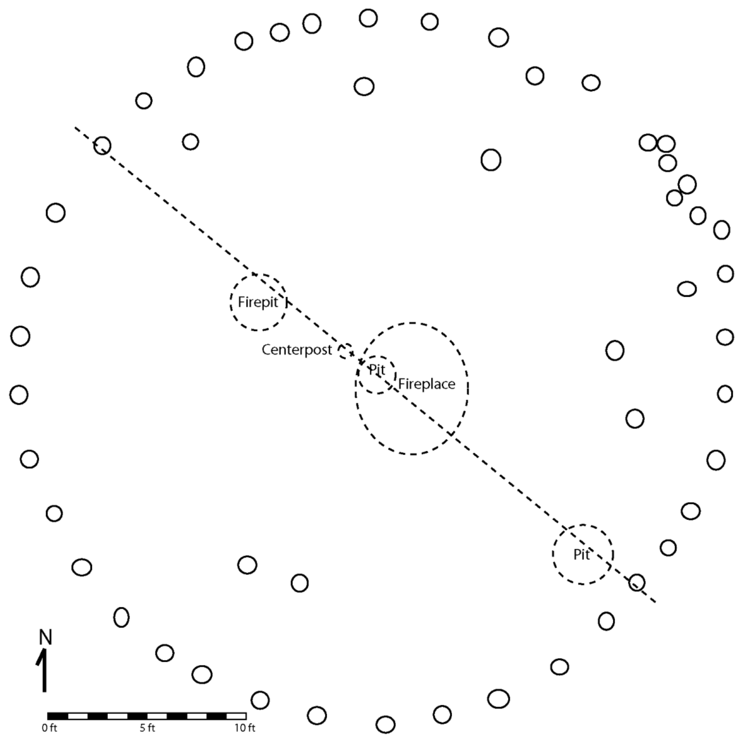

Figure 6.9 – Feature 33 from the George C. Davis site (after Newell and Krieger 1949:Figure 17).

Area B

The gradiometry of Area B (Figure 6.10) produced many anomalies with rectangular or circular patterns. Approximately 50 of these had sufficiently strong geophysical patterns to suggest they were probably structures (Figure 6.10:c).

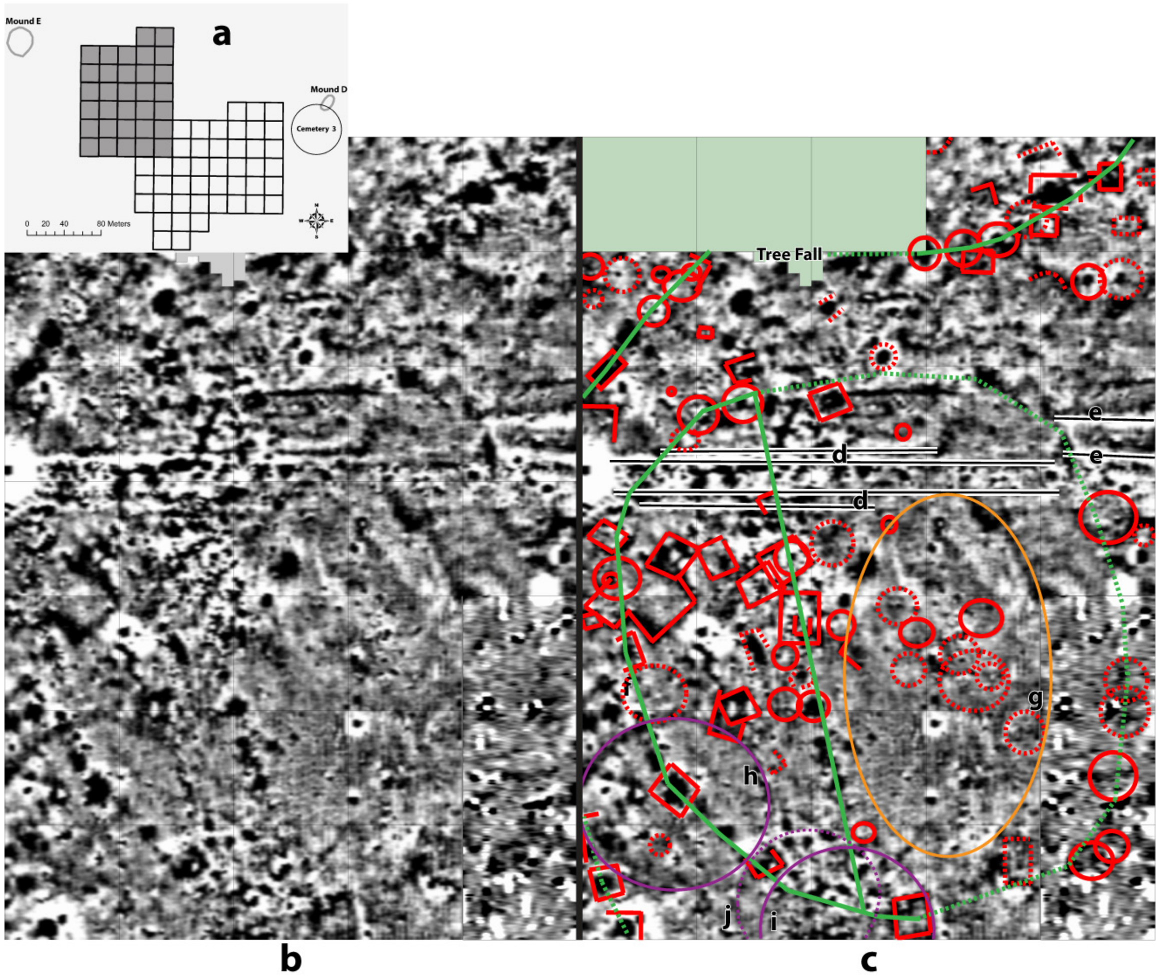

Figure 6.10 – Area B possible structures (red), linear patterns (green), and historic anomalies (b&w): a, position on site; b, gradiometry; c, gradiometry with anomalies marked by letters; d, old historic double fence line; e, modern ditches set on either side of a vehicle pathway; f, possible oval pattern of possible structures and areas of high magnetism; g, possible plaza; h, possible circular enclosure about 35 m in diameter; i-j, possible circular enclosures or large structures about 30 and 25 m in diameter. Areas of increased magnetism are darker and areas of decreased magnetism are lighter. Values are clipped to $\pm$ .5 nT.

Anomalies likely to be caused by the historic use of the Crenshaw site were identified in Area B based on the bipolar signatures produced from metal objects (Figure 6.11). Others of historic origin include a double east-west fence row (Figure 6.10:d) marked by a linear patterning of high and low magnetic values. Two parallel patterns of decreased magnetism are on the east side of the area, just north of the old fence rows

(Figure 6.10:e). These anomalies are from two ditches surrounding a vehicle pathway used by the current land owners. This pathway originates from a barn located just east of the anomalies.

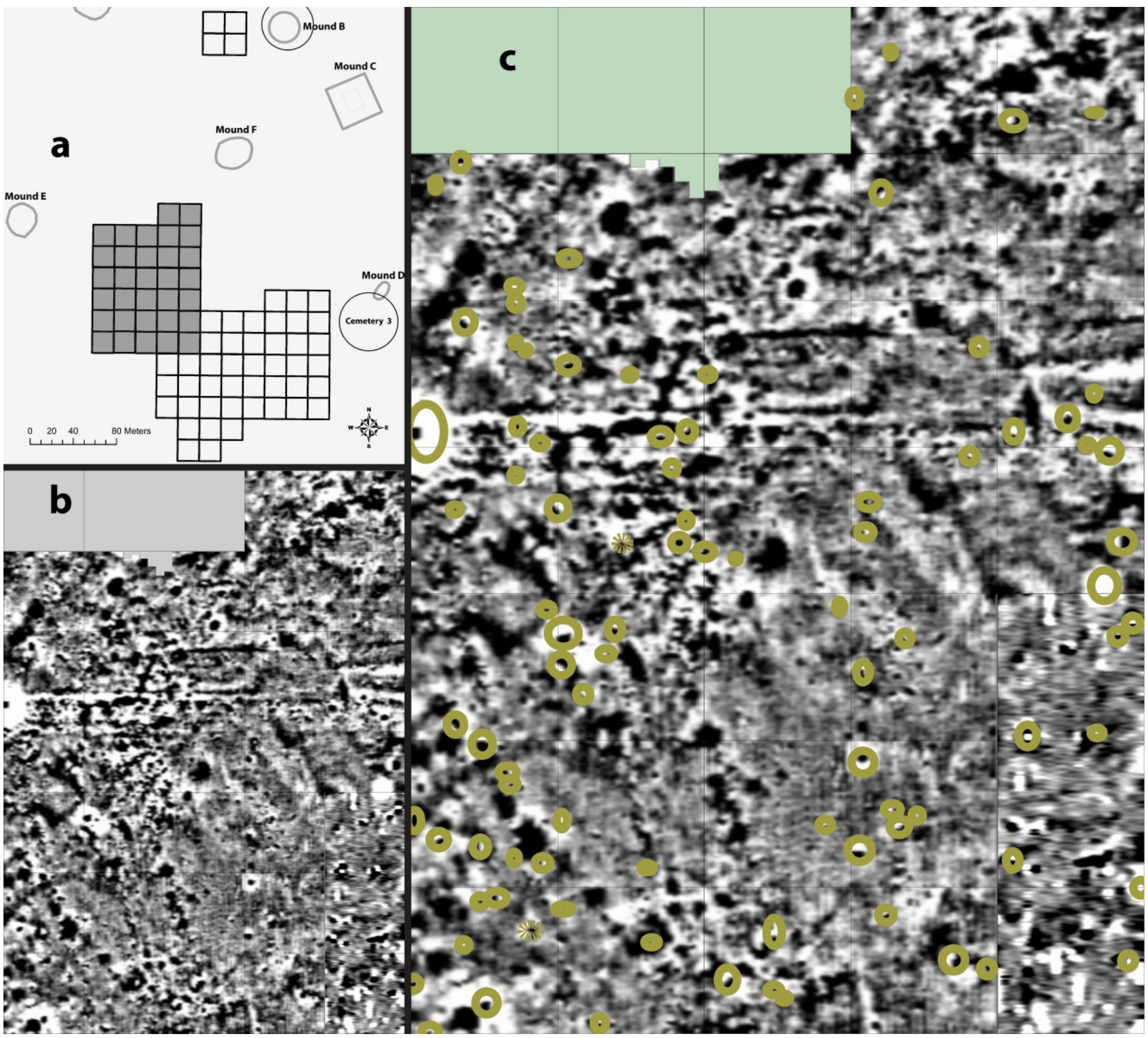

Figure 6.11 – Area B metal scatters: a, position on site; b, gradiometry; c, gradiometry with metal marked.

Several linear patterns of possible structures are apparent in the archaeogeophysical results. There is an arc of possible structures and areas of increased magnetism that may be part of a large 90 x 85 m oval (Figure 6.10:f). An area with little magnetic activity on the eastern side of the oval may represent a plaza (Figure 6.10:g). However, it also corresponds to the small swale in Area B where erosion may have washed away any evidence of structures. That circular structure-sized patterns appear in this area suggest that the remains of a few structures may still be present despite the erosion.

To the northwest of the oval (Figure 6.10:f), there is another possible row of possible structures that continues outside of the grid collection area (Figure 6.12). This hints at the likelihood that there are multiple rows of structures in this area, although more data needs to be collected west of Area B to determine this. There is another curved linear arrangement of possible structures apparent in the northeast portion of Area B (Figure 6.13). One possible rectangular structure, south-southwest of Mound F, approximately 4 x 6 m in size, appears to have an extended entranceway that points due west (Figure 6.13:d). The area just south of Mound F is documented as containing Caddo midden deposits (Schambach 1982a:152). Known Caddo buildings with extended entranceways in the southern Caddo area sometimes point west (21.7% of the time, according to Perttula [2009:Table 5]).

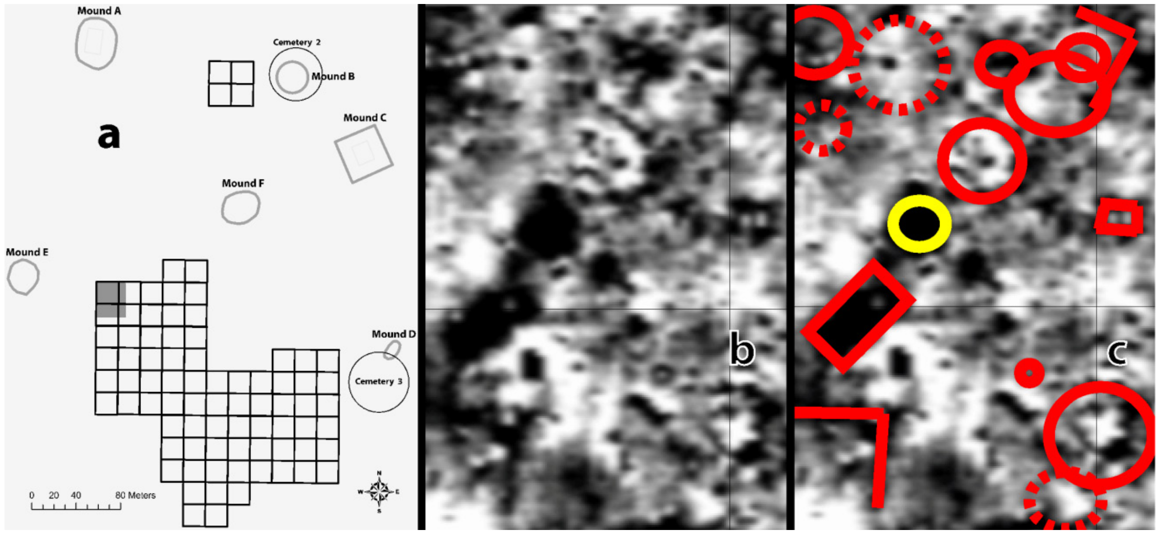

Figure 6.12 – Linear patterns of possible structures and areas of increased magnetism in the northwest corner of Area B: a, position on site; b, gradiometry results; c, gradiometry with possible structures (red) and areas of increased magnetism (yellow) marked. Areas of increased magnetism are darker and areas of decreased magnetism are lighter. Values are clipped to ± .5 nT.

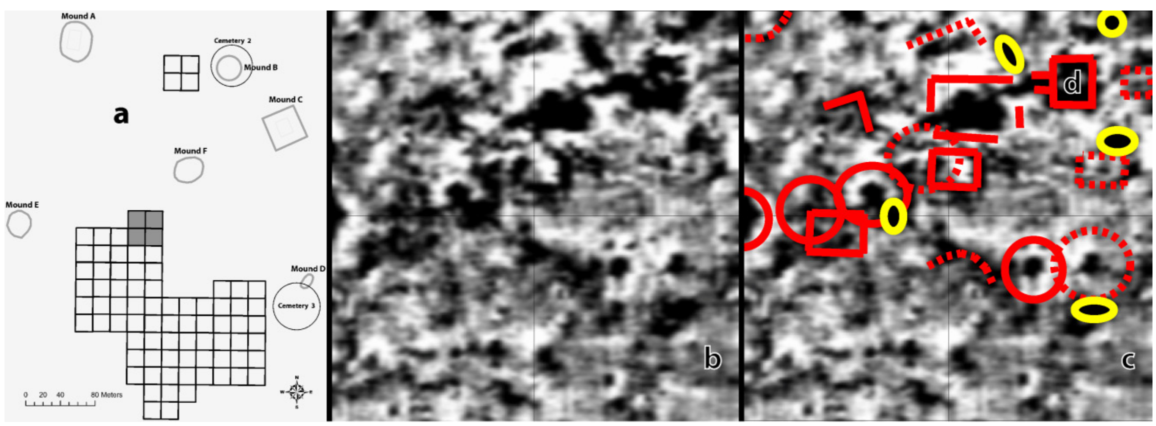

Figure 6.13 – Linear patterns of possible structures and areas of increased magnetism in the northeast corner of Area B: a, position on site; b, gradiometry results; c, gradiometry with possible structures (red) and areas of increased magnetism (yellow) marked; d, possible structure with extended entranceway pointed due west. Areas of increased magnetism are darker and areas of decreased magnetism are lighter. Values are clipped to ± .5 nT.

Area C

Gradiometry, resistance, and GPR in Area C (Figure 6.14:a) all located geophysical anomalies interpreted as possible structures. Areas of historic activity were also identified in this area (Figure 6.14:d), including an old fence that once divided the property (Figure 6.14:g).

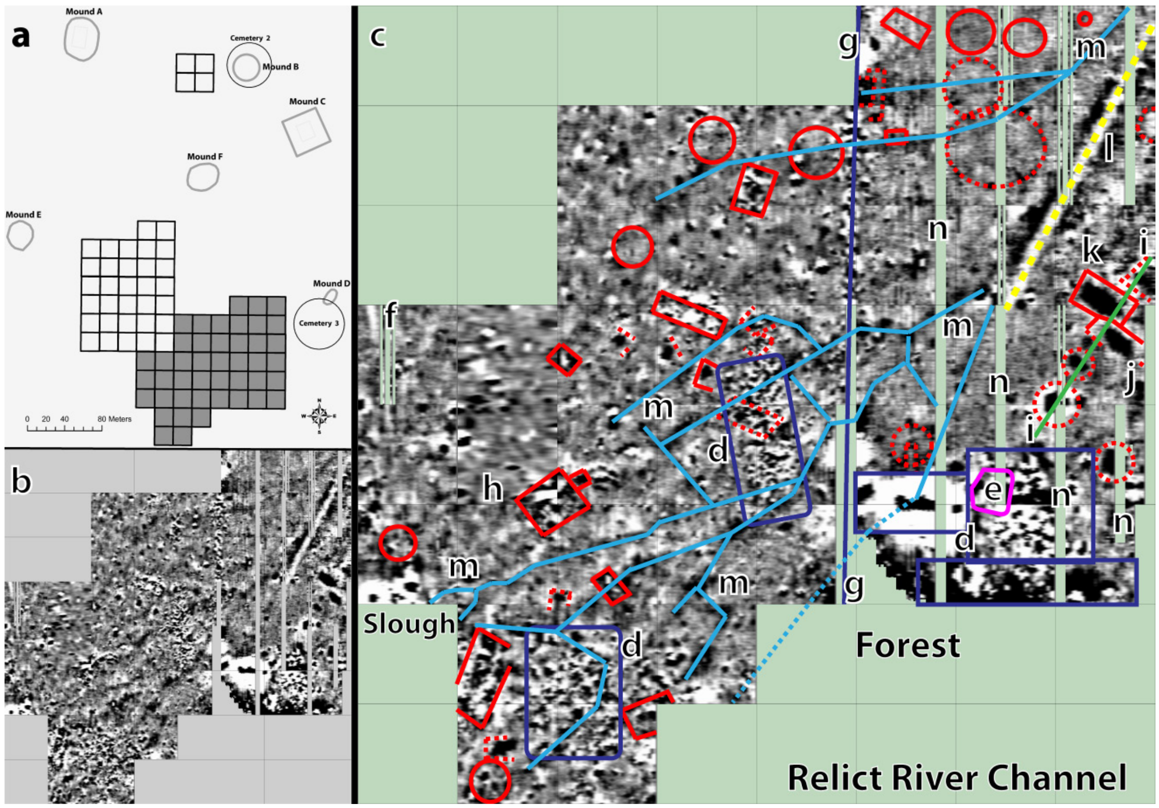

Figure 6.14 – Possible structures (red), linear patterns (green, blue, and yellow), and historic anomalies (dark blue) in the gradiometry of Area C: a, position on site; b, gradiometry data; c, gradiometry with anomalies marked, including: d, areas with high concentrations of metal debris; e, the antler temple; f, tree with a brush pile that limited data collection; g, old fence line piled with brush that caused anomalies and limited data collection; h, possible rectangular structure with an extended entranceway; i, linear pattern of possible structures; j, possible rectangular Fourche Maline structure partially excavated in 1969; k, possible rectangular structure with similar signature to j; l, 60 m long area of low magnetism with linear patterns of high magnetism on its sides; m, linear patterns of high magnetism likely caused by drainages; n, rows of peach trees that limited data collection. Areas of increased magnetism are darker and areas of decreased magnetism are lighter. Values are clipped to ± .6 nT.

Gradiometry again proved most productive in identifying many anomalies that may be structures (Figure 6.14:c). One of these possible structures (Figure 6.14:h), approximately 12 x 13 m in size, appears to have an extended entranceway pointing northeast, which is the best represented direction (30.4%) for known Caddo structures with extended entranceways in the southern Caddo area (Perttula 2009:Table 5).

The gradiometry revealed many pieces of metal debris. There were three areas of concentration (Figure 6.14:d). One was in the south part of Area C, one was in the center of Area C, and one was in the southeastern part of Area C. The two of the concentrations on the western half of Area C have unknown causes, but might be related to old structures as the Second Old River is located just to the south, which was active until about 1864 (see Chapter 4). The other concentration of magnetic anomalies was likely the result of a combination of factors. One reason is that the area is currently used as a dump. Metal debris found in the area includes a sewing machine and a two meter long piece of rebar. Another reason for the existence of metal debris here could be that the location of the 1969 and 1983 excavations was in that area. The most obvious link between the two is the linear magnetic anomaly that corresponds with the trench between the 1969 and 1983 excavations. It is possible that metal debris ended up in the backdirt, forming a strong linear anomaly. However, it is possible that the anomaly is due to metal trash deposited in the trench after it was backfilled.

The resistance data in Area C identified several possible structures (Figure 6.15). The conductivity data identified two rectangular areas similar to rectangular areas detected in the resistance (Figure 6.16).

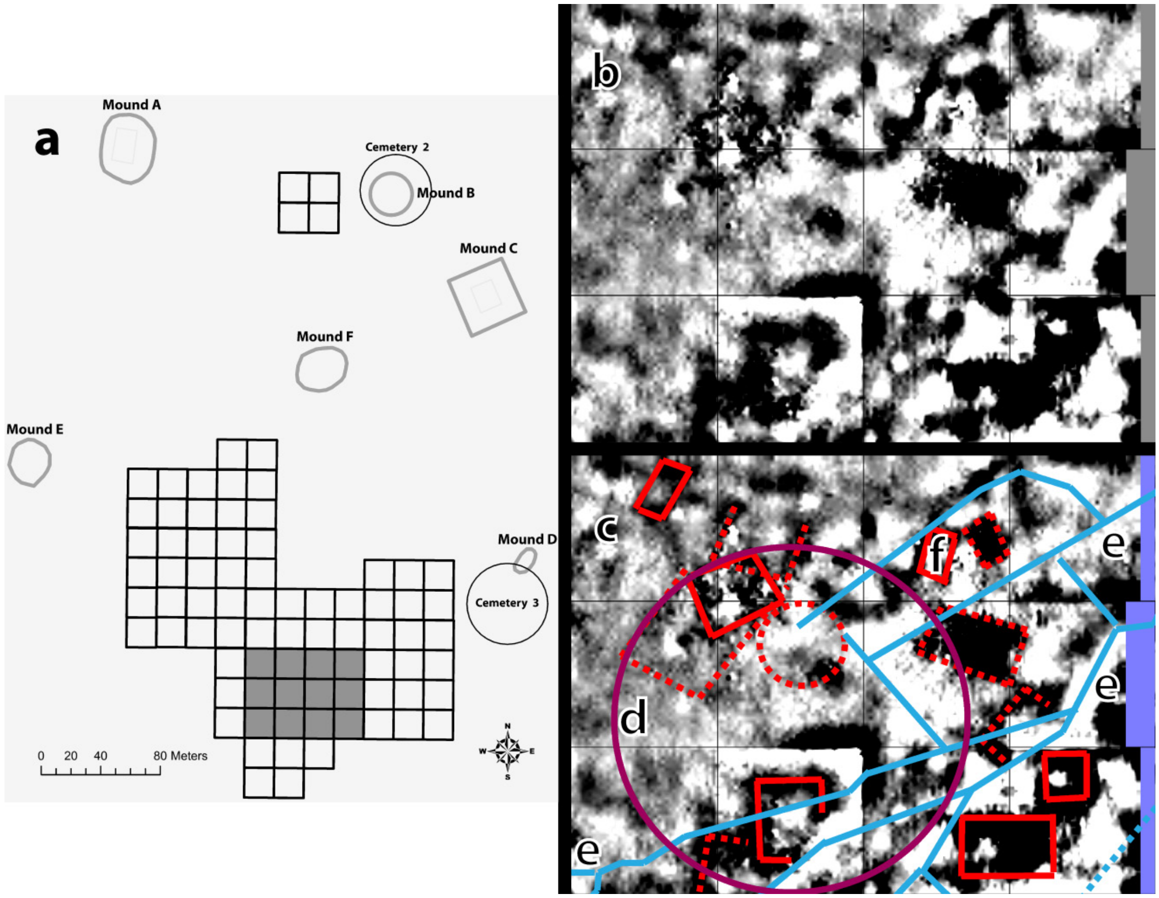

Figure 6.15 – Area C resistance: a, position on site; b, resistance data; c, resistance with possible structures (red) and linear anomalies (blue) marked as follows: d, 48 m diameter circular anomaly possibly indicating a compound fence; e, linear patterns marked in the gradiometry data overlain on the resistance data, showing that low resistance values are commonly associated with these patterns as would be expected if they are due to the presence of drainages; f, possible structure also seen in gradiometry. Areas of increased resistance are darker and areas of decreased resistance are lighter. Values are clipped to ± .6 standard deviations.

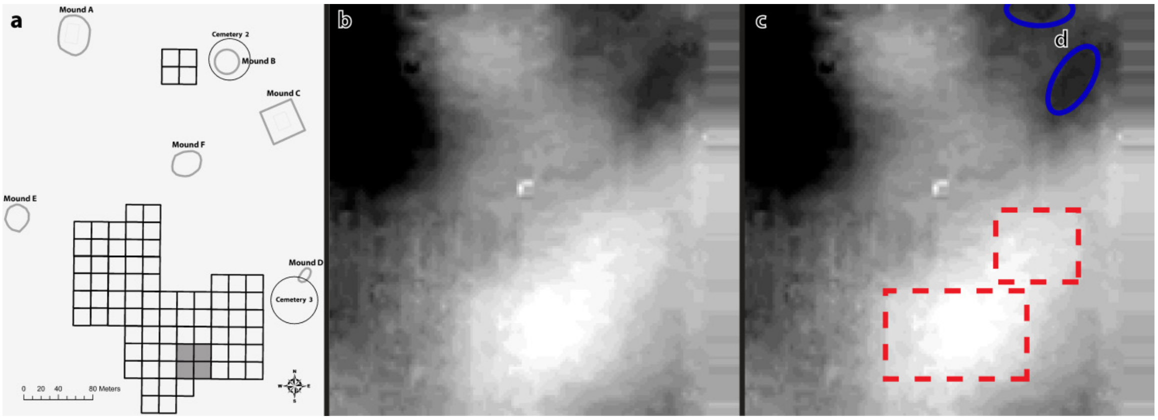

Figure 6.16 – Area C conductivity: a, position on site; b, conductivity results; c, conductivity with possible structures (red); d, possible burial pits. Areas of increased conductivity are darker and areas of decreased conductivity are lighter. Values are clipped to $\pm$ 1.5 standard deviations.

Some technologies supported the interpretations of possible structures that were found in other technologies (Figure 6.17). One example of this is a possible rectangular structure with an extended entranceway identified by the anomalies seen in the GPR and gradiometry (Figure 6.18:e; Figure 6.17:j). The GPR profiles provide further support for this interpretation, including a cross section of the possible structure floor (Figure 6.19:c) and the possible extended entranceway (Figure 6.19:d). These results also support the interpretation of two possible circular structures (Figure 6.19:b; Figure 6.18:c; Figure 6.17:j) to the south of the possible rectangular structure that may represent storage bin platforms or other ancillary facilities (e.g. Schambach 1982c:121). The gradiometry and resistance data both identified a single small possible rectangular structure (Figure 6.15:f; Figure 6.17:h). The presence of a similar anomaly in the magnetic susceptibility data (Figure 6.20:d; Figure 6.17:i) further supports the interpretation from the gradiometry data that one possible rectangular structure was present in Area C.

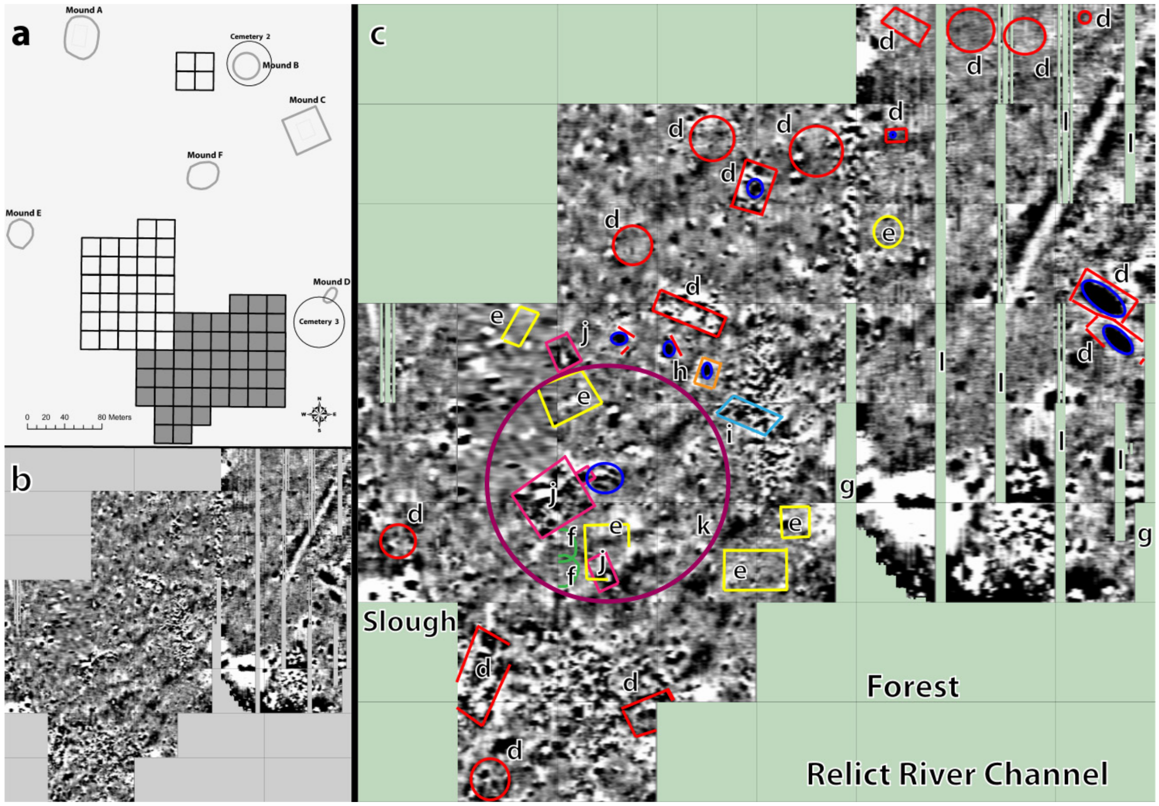

Figure 6.17 – Area C possible structures with strong patterns from multiple technologies: a, position on site; b, gradiometry; c, gradiometry with anomalies from multiple technologies marked; d, possible structures seen in gradiometry; e, possible structures seen in resistance; f, possible structures seen in GPR; g, brush that limited data collection; h, possible structures seen in resistance with support from gradiometry; i, possible structures seen in gradiometry with support in magnetic susceptibility; j, possible structures seen in gradiometry and GPR; k, 48 m circular anomaly from resistance encircling possible structures; l, rows of peach trees that limited data collection. Areas marked with dark blue are anomalies that may be associated with a structure. Areas of increased magnetism are darker and areas of decreased magnetism are lighter. Values are clipped to ± .6 nT.

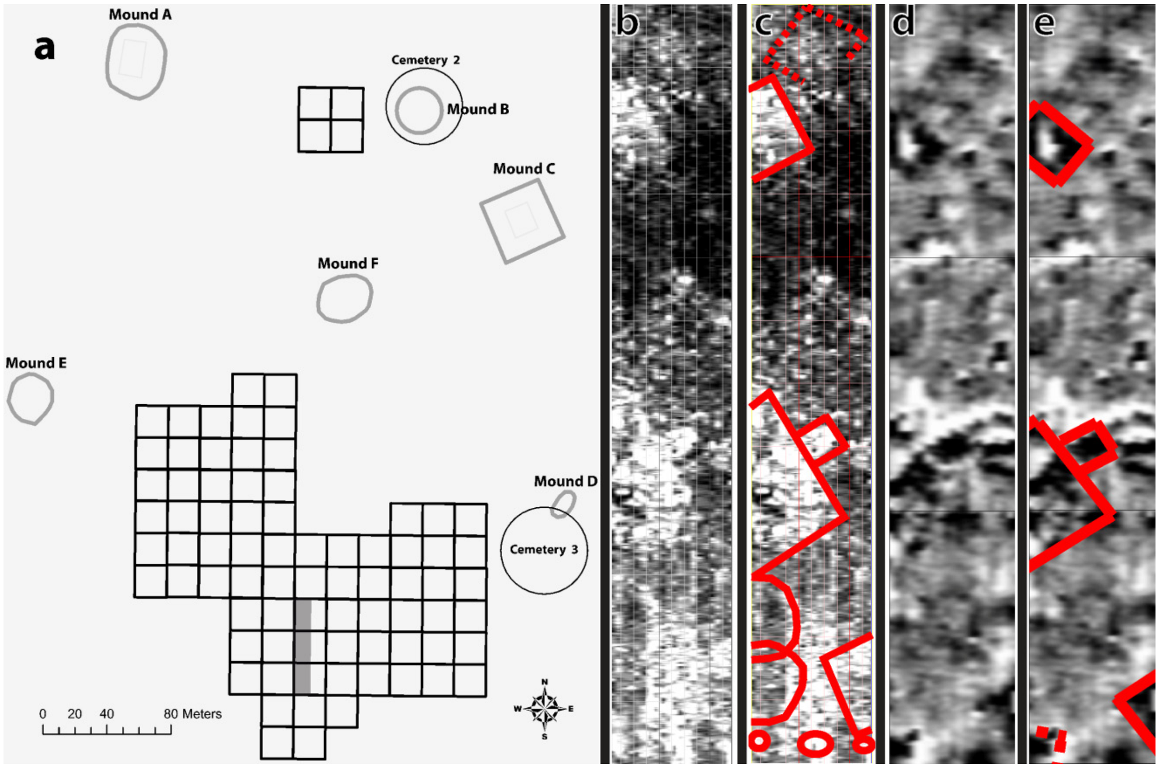

Figure 6.18 – Area C gradiometry and GPR comparison: a, position on site; b, GPR slice 66 cm bs and 15 cm wide; c, GPR slice with possible structures and possible pits overlain; d, gradiometry data; e, gradiometry data with possible structures overlain. In the gradiometry data, areas of increased magnetism are darker and areas of decreased magnetism are lighter. Values are clipped to ± .6 nT.

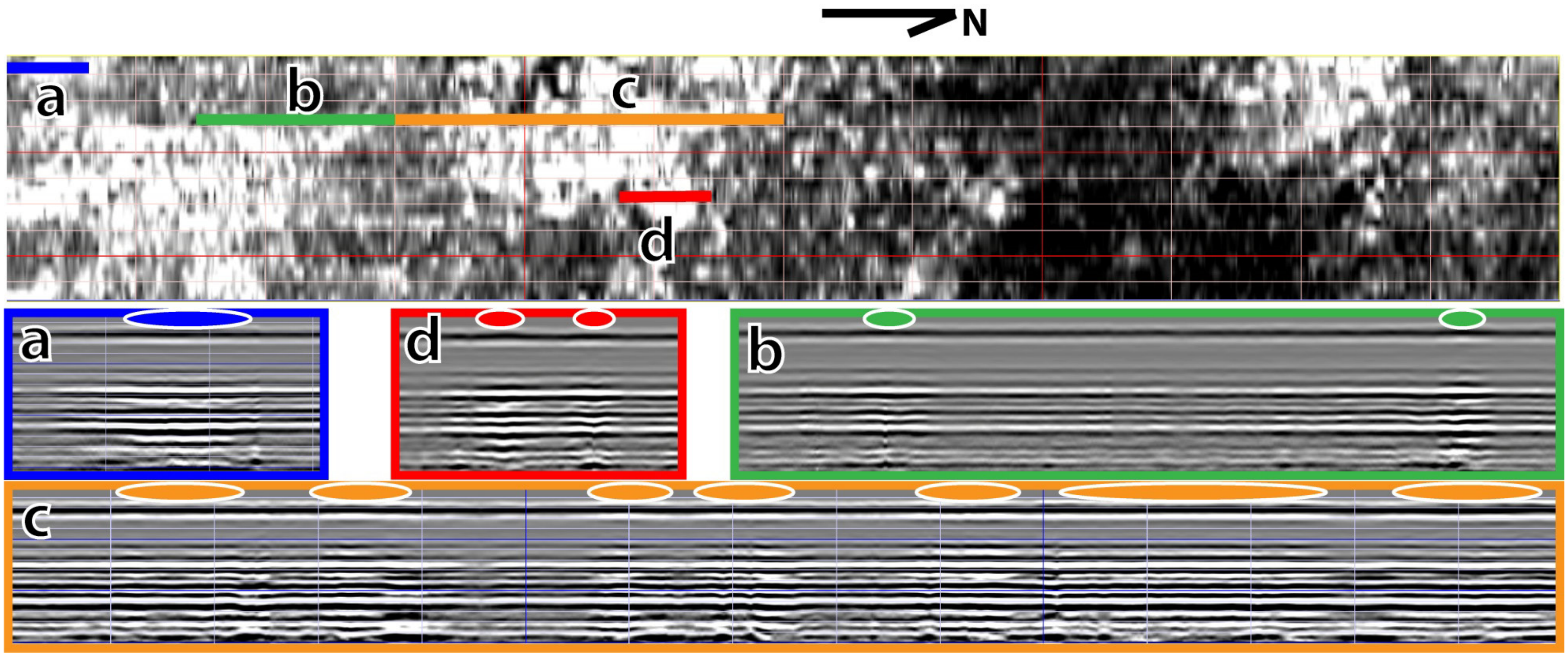

Figure 6.19 – Area C GPR slice at 66 cm bs and 15 cm wide with profiles showing further support for interpretations. Top image is a slice while the other four images are the corresponding profiles of the anomalies: a, possible pit associated with 48 m circular anomaly in the resistance data (Figure 10d); b, set of possible post holes in a cross section of a possible circular structure; c, heavy activity shown on the floor of the possible rectangular structure with an extended entranceway; d, cross section of the possible extended entranceway showing two areas of disturbance on either side of the possible entranceway floor, possibly indicating entranceway posts or trenches.

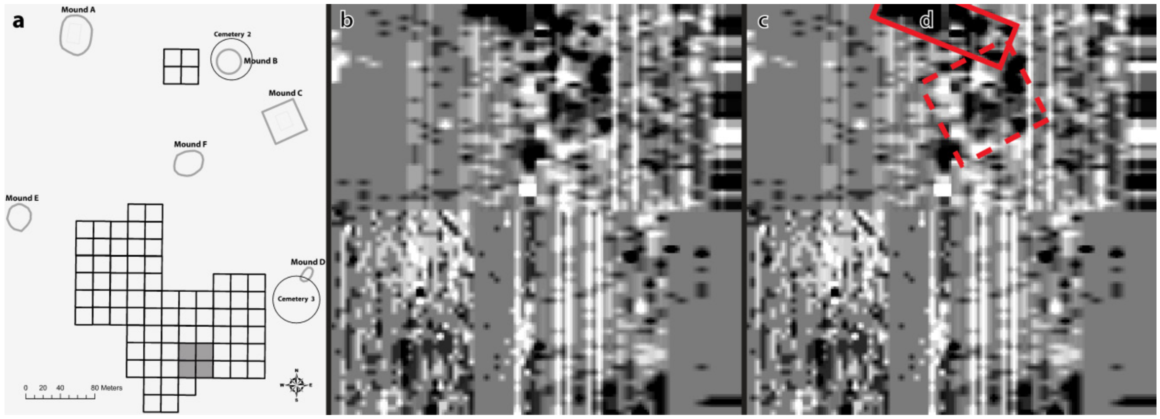

Figure 6.20 – Area C magnetic susceptibility: a, position on site; b, magnetic susceptibility results; c, magnetic susceptibility with possible structures; d, possible structure with similar pattern in gradiometry. Areas of increased magnetic susceptibility are darker and areas of decreased magnetic susceptibility are lighter. Values are clipped to ± 2.0 standard deviations.

The interpretation of the anomalies in Area C depended on the location of the 1969 and 1983 excavation areas. A datum from the 1983 excavations and a permanent datum (located 190 m north and 65 m west of the origin) were found and shot in with a total station, which created two points of reference between the new grid system and the 1983 coordinate system. Using diagrams made during the 1983 excavation and some of the anomalies found in gradiometry, the location of the 1969 and 1983 excavations were plotted in the new grid system. The difference between the old coordinates and new coordinates of the 1969 and 1983 datums is due to a large difference in the north lines between the old coordinate system and the new coordinate system. The placement of the old excavations was verified by using ArcMap to create two lines connected at a right angle measuring 190 x 65 m. One end of the lines was connected to the permanent datum. The lines were then rotated around the permanent datum. The other endpoint of the lines had to intersect the origin datum from 1969 regardless of the north line used. The end point intersected the origin datum at the same location that was calculated based on the 1983 datum, the 1983 diagrams, and the location of anomalies in the gradiometry, confirming its location and the north line used in 1969. The north line used in 1969 was about 7 degrees further east than the new north line, which is more in line with the old fence separating the properties in the middle of the site. In this way, the locations of the North and West Skull Areas (Figure 6.21) and the antler temple (Figure 6.21:c) were plotted with the gradiometry.

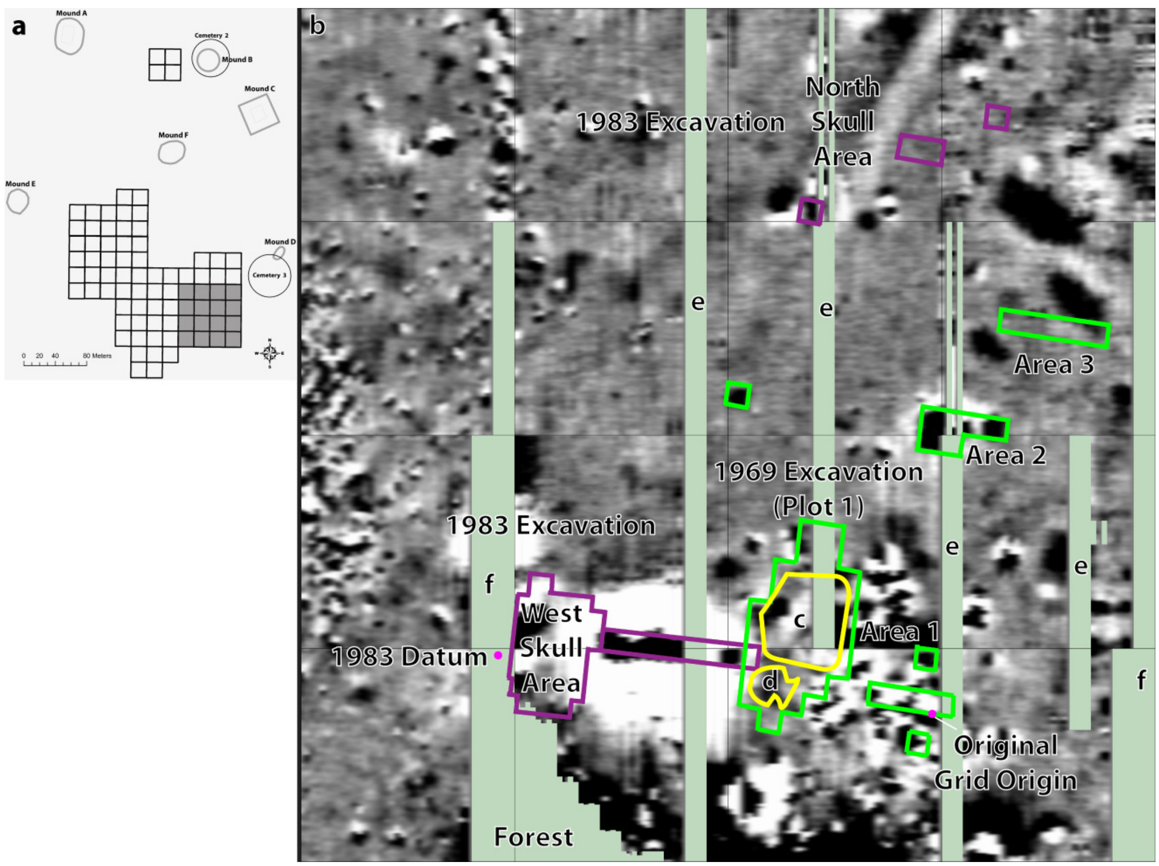

Figure 6.21 – Previous excavations in Area C: a, position on site; b, gradiometry with previous excavations; c, the antler temple; d, the antler pile with over 2000 deer antlers; e, rows of peach trees that limited data collection; f, brush that limited data collection. Areas of increased magnetism are darker and areas of decreased magnetism are lighter. Values are clipped at $\pm$ 1 nT.

There is a linear arrangement in the gradiometer data of possible structures (Figure 6.22:k) just northeast of the antler temple (Figure 6.22:j). This area corresponds with the edge of a Fourche Maline midden found in 1969 excavations by Frank Schambach. Three of the possible structures in this linear arrangement were partially excavated by him in 1969 (Figure 6.22:e-g). While these areas were not determined to be definite structures, the information was complex and only portions of the possible structures were revealed. One of these possible structures (Figure 6.22:f) was circular and only partially intersected the southwest portion of Plot 1 Area 3. A postmold was found in the location where a line of decreased magnetism intersects the previous excavation. Another possible circular structure (Figure 6.22:g) was excavated in Plot 1 Area 2 where a large ash pit, Feature 4 (Figure 6.23), was discovered in the center of the circular anomaly. Frank Schambach's notes indicate that he thought this could be a structure, but he was unable to find a posthole pattern to confirm this. The anomaly in the gradiometry suggests a circular pattern of postholes may exist around Feature 4 based on the circular area of decreased magnetism. Where the circular pattern intersects the excavation, a postmold was found. However, caution should be exercised as the excavation itself may have caused this area of decreased magnetism if low magnetism subsoil was left on the surface around the units or if the area of decreased magnetism is being created by a halo effect. The area of the third anomaly, a possible rectangular structure (Figure 6.22:e), was interpreted by Schambach as a tree throw that was later filled with midden. These possible structures are represented as areas of increased magnetism surrounded by areas on low magnetism. This could be attributed to a natural phenomenon where areas of high magnetism are surrounded by a halo of low magnetism, which might be incorrectly interpreted as a surrounding wall. However, in the case of the two possible rectangular structures (Figure 6.22:d-e), their magnitudes (around 1.5-2.0 nT) are probably not high enough to create such an effect and the areas of high magnetism are oval in shape while the areas of decreased magnetism are rectangular in shape. If a halo effect caused the outlines, the shape of the area of decreased magnetism should be the same as the area of increased magnetism.

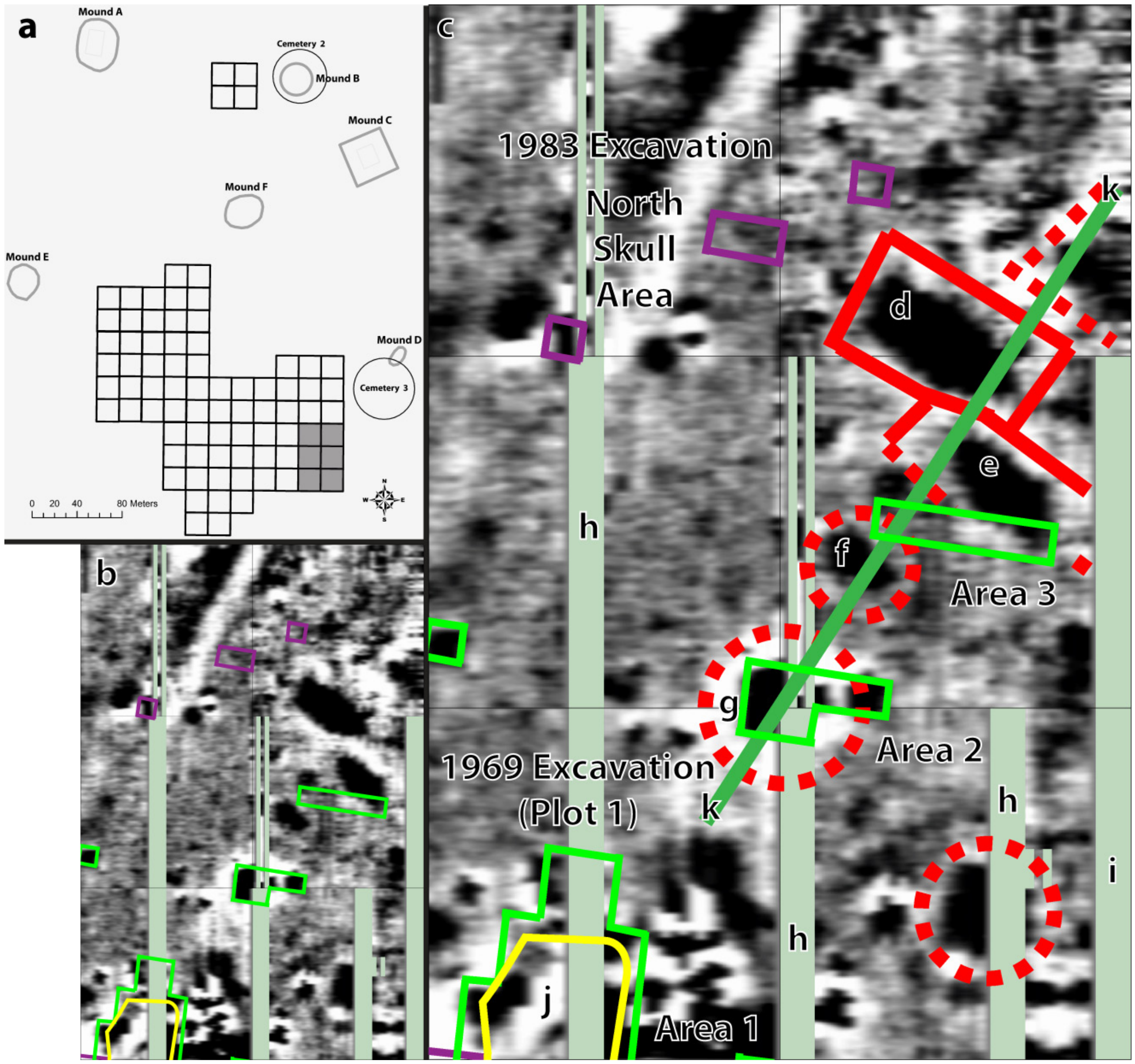

Figure 6.22 – Previous excavations in Area C with possible structures (red): a, position on site; b, gradiometry with previous excavations; c, gradiometry with previous excavations and possible structures; d, possible rectangular structure (internal area of high magnetism averages 2.0 nT in magnitude); e, possible rectangular structure that was intersected by the 1969 excavation (internal area of high magnetism averages 1.5 nT in magnitude); f, possible circular structure that was intersected by the 1969 excavation; g, possible circular structure that was mostly excavated by the 1969 excavation; h, rows of peach trees that limited data collection; i, brush that limited data collection; j, the antler temple. Areas of increased magnetism are darker and areas of decreased magnetism are lighter. Values are clipped at ± 0.6 nT.

Figure 6.23 – Feature 4 from the 1969 excavation corresponding to the center of a possible circular structure (Figure 6.22:g).

This possible structure was partially excavated in Plot 1 Area 3 where six 2 x 2 m units were excavated in a trench east to west and given names from E0N38 to E10N38 based on their position from the excavation datum. The three eastern most units, E6N38, E8N38, and E10N38, had evidence of this feature.

In the first layer of excavation of E8N38, the recorders, Frank Schambach and Rhine Condray, described the feature as “greasy black sandy soil” containing “good habitation refuse” and adding that it “looks like a living area rather than a swamp dump.” The recorders noted the presence of large Coles Creek pottery sherds. Also found in this cut was bones and stone. In Frank Schambach’s notes (1969), he talks about that area on October 2, 1969:

> Opening a line of 3 squares east of E0N38 in a last try for pits and molds in Plot 1. Got one small pit (Fea 5) in E4N38. Nothing in it however and no post holes. Would be nice if there was some daub to help us zero in on house locations but I've yet to see a piece of it on this site. Condray is getting quite a few very large sherds from E6N38 so maybe we're on a house floor or in the top of a pit there.

October 8:

> Continuing E20N26 and E22N28 to increase the pottery sample from this part of Plot 1. Opening E8N38 at east end of the N38 trench. This trench gets progressively darker to the east and appears to be running into the same midden and same component being exposed in and around E20N26 and E22N28. No Pennington in the N38 trench either.

October 9:

> The N38 trench is becoming increasingly productive as we move it east. Much pottery with many sherds hand sized or better to indicate that it hasn't been walked on very much.

October 15:

> Looks like we may have inadvertently dug through a pit in the N38 trench. We saw outlines and drew them in as best we could but could never be sure of what was pit and what was midden. I expected it to extend into the subsoil where we could get its outlines and handle it as a feature but it didn't go that deep. I'm still not convinced it was a pit and not a tree fall hollow or some other natural depression that got filled with refuse. This occurs in E8N38 and E10N38. There's at least half of it left in E8N40 and E10N40 so we may work it out and give it a feature number. Soil is greasy black sand that should float well.

The notes show that the possibility of a house floor in E6N38 was considered at the time of excavation. The pit extends from the north wall to the southeast in the level sheets, meaning that it was not in E6N38. Due to time constraints and the discovery of the antler temple, the excavation never moved to sections north of the trench.

The excavation records, photographs, and profiles provide more support for this anomaly being a structure. However, some of the information from the original excavation had to be reviewed for accuracy due to the complex nature of this feature. The profiles showed confusing stratigraphy (Figure 6.24). Fortunately, several color and black and white photographs were taken of the north wall of the trench where the stratigraphy could be reconstructed (Figure 6.25; Figure 6.26). The profiles, images, and excavation records suggest that the artifacts and midden extended around the pit to the western edge of E6N38 where a post hole was found. This post hole can be seen originating from the dark sand. Another possible postmold can be seen in the photograph to the southeast of the first postmold. This stain, however, was not marked in the original documents. A deposit of light sand was discovered at the bottom of the pit and shows a mostly straight horizontal line in the profile. When this information is combined with the size and orientation of the anomaly in the gradiometry, several of these traits suggest that this may be a structure. The two possible postmolds would form a line in the same location and orientation that the rectangular area of decreased magnetism passes through. This suggests that the rectangular area of decreased magnetism may be due to postmolds. The one postmold that was excavated was about 20 cm in diameter and appears to be approximately 60 cm deep in the profile photographs. A line of postmolds this size could cause a linear anomaly of decreased magnetism in gradiometry. This particular postmold was charred, which could cause a small increase in magnetism that might not be distinguishable from the surrounding midden. The signature for this wall in the gradiometry is not very strong compared to the northeast and northwest walls. This may suggest that this wall was burnt, making it less distinguishable from the surrounding midden.

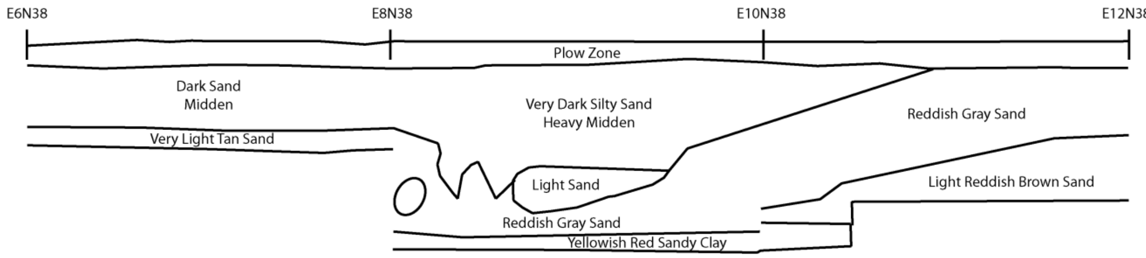

Figure 6.24 – Original stratigraphy of the north wall of the N38 trench from Plot 1 Area 3 of the 1969 excavation that intersects a possible rectangular structure (Figure 6.22:e).

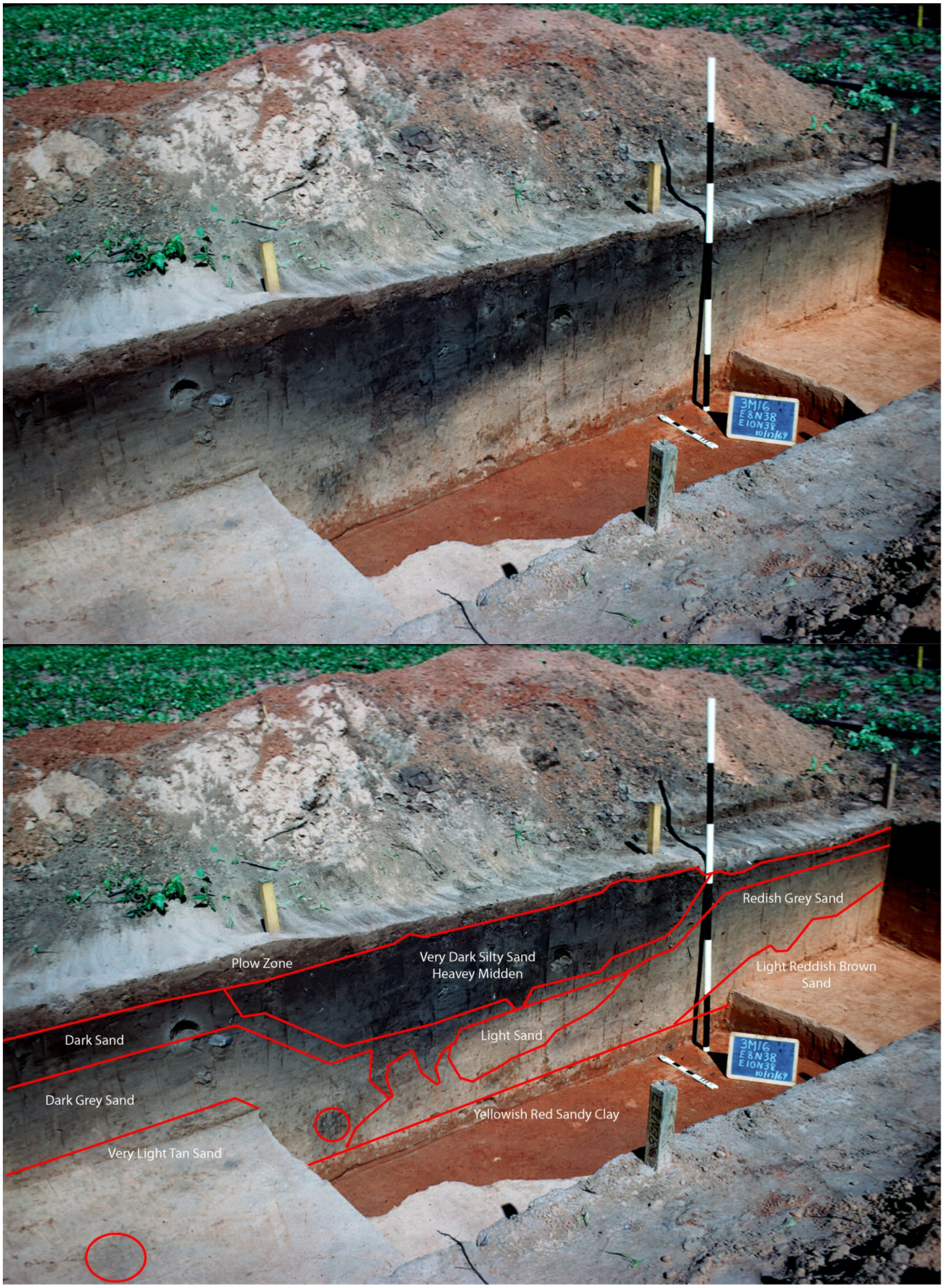

Figure 6.25 – North wall of the N38 trench looking northeast. Stratigraphy marked on bottom. Light sand is deposited on the bottom of the pit with a straight horizontal line on top. Circled stain shown on bottom left not originally recorded.

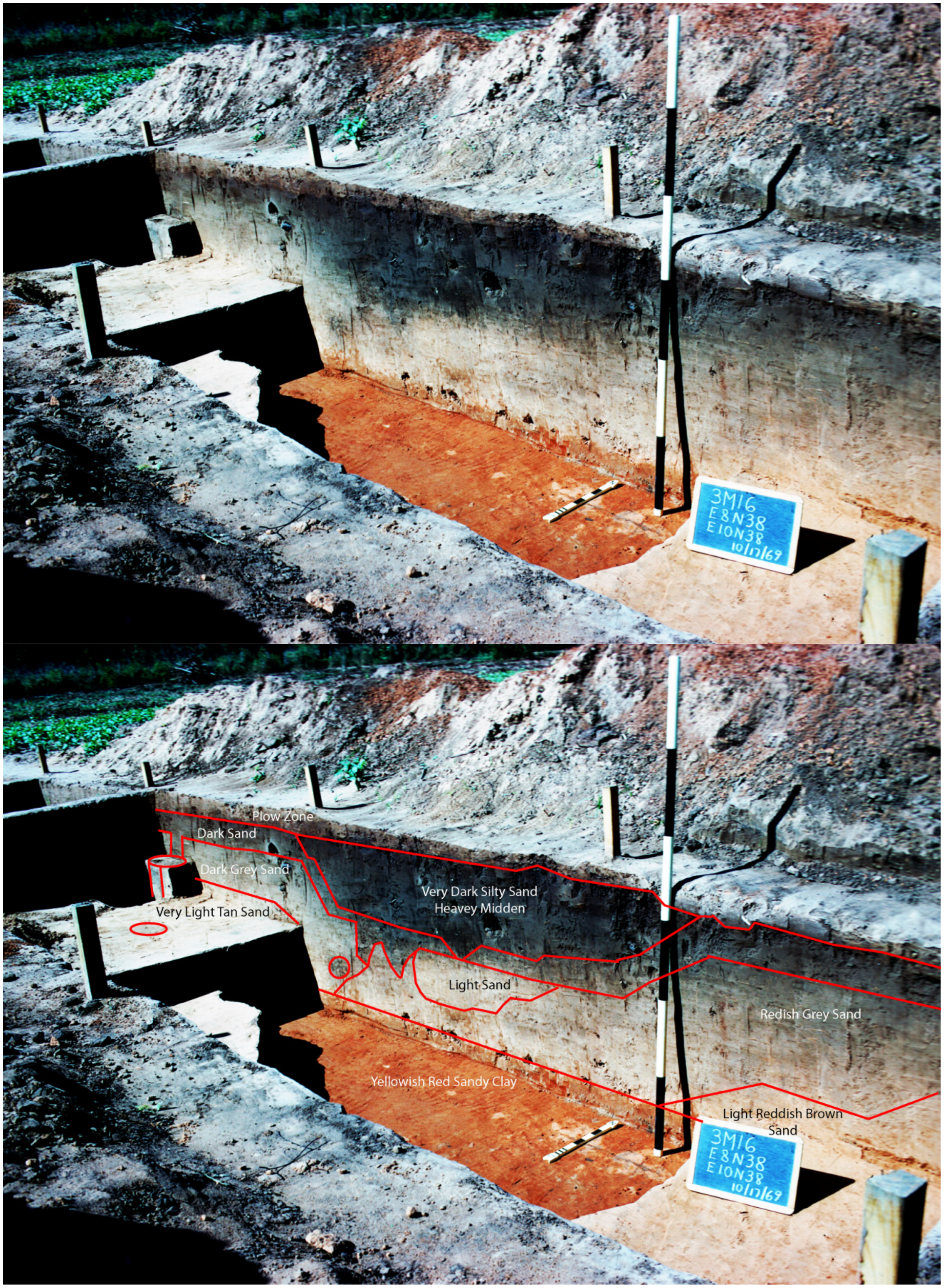

Figure 6.26 – North wall of the N38 trench looking northwest. Stratigraphy marked on bottom. A wall for this possible structure would have exited where the two possible postmolds are marked on the left. Circled stain on left not originally recorded.

The pit full of midden is responsible for the increased magnetism in the center of the possible rectangular structure. The deposit of light sand at the bottom of the pit could represent a prepared floor as it creates a straight horizontal line in the profile. In the third layer of excavations of E8N38, approximately the level where this horizontal line occurs, many stains and large sherds were discovered in the area of the pit, suggesting the possibility of a floor. The dark areas to the west of the light sand in the profile correspond to two of these stains.

While, according to Schambach (2001), no conclusively Fourche Maline houses used exclusively for habitation have been discovered, two Fourche Maline structures have been excavated. At the Cicero Young mound (3LA7), half of a circular structure in the form of 20 small postmolds was excavated beneath a 3.0 m high and 19.8 m wide Fourche Maline mound. This structure was 5.6 m in diameter and contained a large 1.0 m oval fire pit with cremated human bone in the center of the structure. The pit had a basal diameter of .7 m and was about 75 cm deep. No midden was found in the vicinity of the mound (Schambach 1982b:146). At the Bellevue mound in Bossier Parish, Louisiana, another Fourche Maline structure was excavated beneath the mound (Figure 6.27). This structure was formed by a sub-rectangular pattern of postmolds enclosing a large central pit. The structure was 3.0 x 3.6 m in diameter with posts separated by .3 to 1.0 m. Some of the posts were not small, as they were 10 to 20 cm in diameter and were placed 30 to 45 cm beneath the surface. The oval pit was 1.6 x 2.0 m in diameter, 15 to 20 cm deep, and was placed mostly in the center of the structure. The bottom of the large central pit was filled with white sand and an ash bed was located along the edge of the pit. Inside the pit there was a possible central postmold 41 cm in diameter that extended 61 cm below the surface. Two possibly disturbed burials were also located in the pit with some charred bones. It was interpreted as a crematorium based on its small size and the partially burnt burials (Fulton and Webb 1953:27). These structures indicate that Fourche Maline structures can have small or large posts and central pits that take up about one third of the interior surface area. According to Schambach (1997), the two associated mounds date to about 200 B.C. and have been linked to the early mounds at Crenshaw. However, there is a large gap between the time the mounds were created and the time Crenshaw was first occupied.

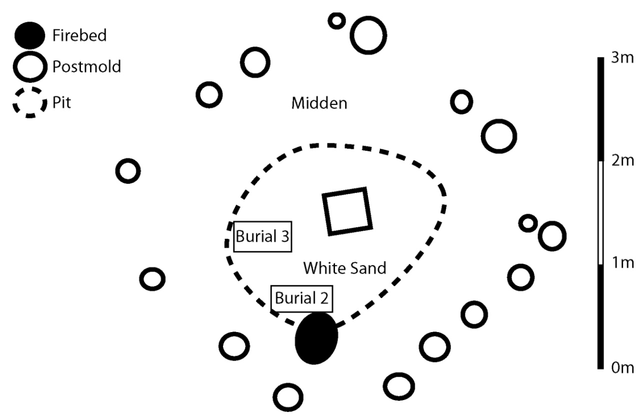

Figure 6.27 – Fourche Maline structure at the Bellevue mound (after Fulton and Webb 1953:Figure 3).

The Bellevue mound structure in particular compares well with the possible structure from Crenshaw. The larger exterior post holes for the Bellevue mound structure measured 20 cm in diameter, about the same size as the two possible post holes. The pattern in the gradiometry would suggest a rectangular line of postmolds surrounding a pit, like the possible structure. The white sand deposited at the bottom of the Bellevue mound structure compares with the light sand that is deposited at the bottom of the pit.

Midden is found around both the Bellevue mound structure and the possible structure at Crenshaw. However, three significant differences remain. The possible Crenshaw structure is much larger, contains large amounts of artifacts and habitation refuse, and the part that has been excavated did not contain human remains. This suggests that the possible Crenshaw structure may not be a crematorium, but a living area. However, the material from this area has not been formally analyzed and only a small potion has been excavated, so conclusions are preliminary. The placement of this possible structure is close to the estimated position of Cemetery 3 (Figure 6.3), so the possibility of this being a crematorium or some kind of charnel house should not be ruled out without further study. A possible sequence that would explain the anomaly and features is as follows. The floor of the structure was made by depositing the light sand inside the pit after it was dug. The pit then sloped up at a moderate angle where another floor was located. A layer of midden was deposited that continued outside the pit to the surrounding floor of the structure. After the structure was no longer in use, it became a refuse filled pit. The interpretation of this anomaly as a possible structure is very tenuous and needs groundtruthing.

Possible Circular Enclosures

The large circular anomalies (Figure 6.10:h-j; Figure 6.15:d) in Area B and C (25 to 48 m in diameters) may represent compound fences or very large structures. Several possible circular structures around 20 m in diameter were found in a gradiometry survey of the George C. Davis site, including two very large structures that were 23.5 m and 25 m in diameter (Creel et al. 2005). An even larger Caddo structure was excavated at the

Werner Mound site in northwestern Louisiana that measured between 25 and 28 m in diameter (Webb 1983:221). The 35 m circular anomaly in Area B is centered on a possible structure and has a wide linear pattern which suggests it is more likely a compound fence than a structure. The other two large circular anomalies have thin linear patterns and are closer to the size of possible Caddo structures, but are still more likely also compound fences. If these large circular anomalies are structures, they would be some of the largest structures on record in the region.

Area B

Two large circular areas, one ca. 35 m in diameter (Figure 6.10:h) and the other ca. 30 m in diameter (Figure 6.10:i), appear in the Area B gradiometry. The larger one is centered on a large possible rectangular structure and consists of an area of increased magnetism. The other anomaly also consists of an area of increased magnetism. It has a possible structure within the circle, but the possible structure is not centered within it. A third circular anomaly, about 25 m in diameter, can also be seen in this area, but has a weaker magnetic pattern (Figure 6.10:j). Each of these anomalies may represent circular enclosures comparable to those on the Teran map. At the Hardman site (3CL418), a portion of a circular pattern of post holes approximately 25 m in diameter was excavated and interpreted to be a likely compound fence (Williams 1993).

Area C

The circle of increased resistance values with a 48 m diameter in Area C may be a large compound fence (Figure 6.15:d) that enclosed some of the possible structures in this area (Figure 6.17:k). This large circular anomaly has within it a possible rectangular structure with an extended entranceway, as well as several other possible structures. Several other possible structures border, but are outside of, this possible compound fence.

Other Anomalies

Area A

Many other circular anomalies appeared in the 1969 aerial photograph (Figure 6.6). Some of these may represent possible structures, but the anomalies are not easily seen. It is possible that some of the smaller anomalies seen in the aerial photograph could be like the structures seen around houses in the Teran map, such as drying racks and storage platforms. Such structures would be less likely to appear in ground-based archaeogeophysical results. Another explanation for the large number of circular anomalies in the aerial photograph could be old cattle feeding circles. Historic accounts suggest the area around Area A was used for pasture (see Chapter 3). One anomaly (Figure 6.28:d; Figure 6.29:e) suggests that cattle or other animals might have been raised in Area A. Cattle can create circles in aerial photography by trampling the ground around a feeding area. This effect can be seen at Crenshaw in recent aerial photography of the northern portion of the site not included in this study (Figure 6.30). Most of the cattle circles are between seven and nine meters in diameter. This happens to also be a good size for a Caddo house. However, smaller interior circles may also form around the hay. Therefore, finding circular anomalies in aerial photography alone cannot be used to verify the presence of circular structures. It is unknown if these circles would also affect ground based archaeogeophysics, but compacting of earth and removal of top soil during times of extreme water saturation are possibilities. The area that is now being used for cattle at Crenshaw is not connected to the study area.

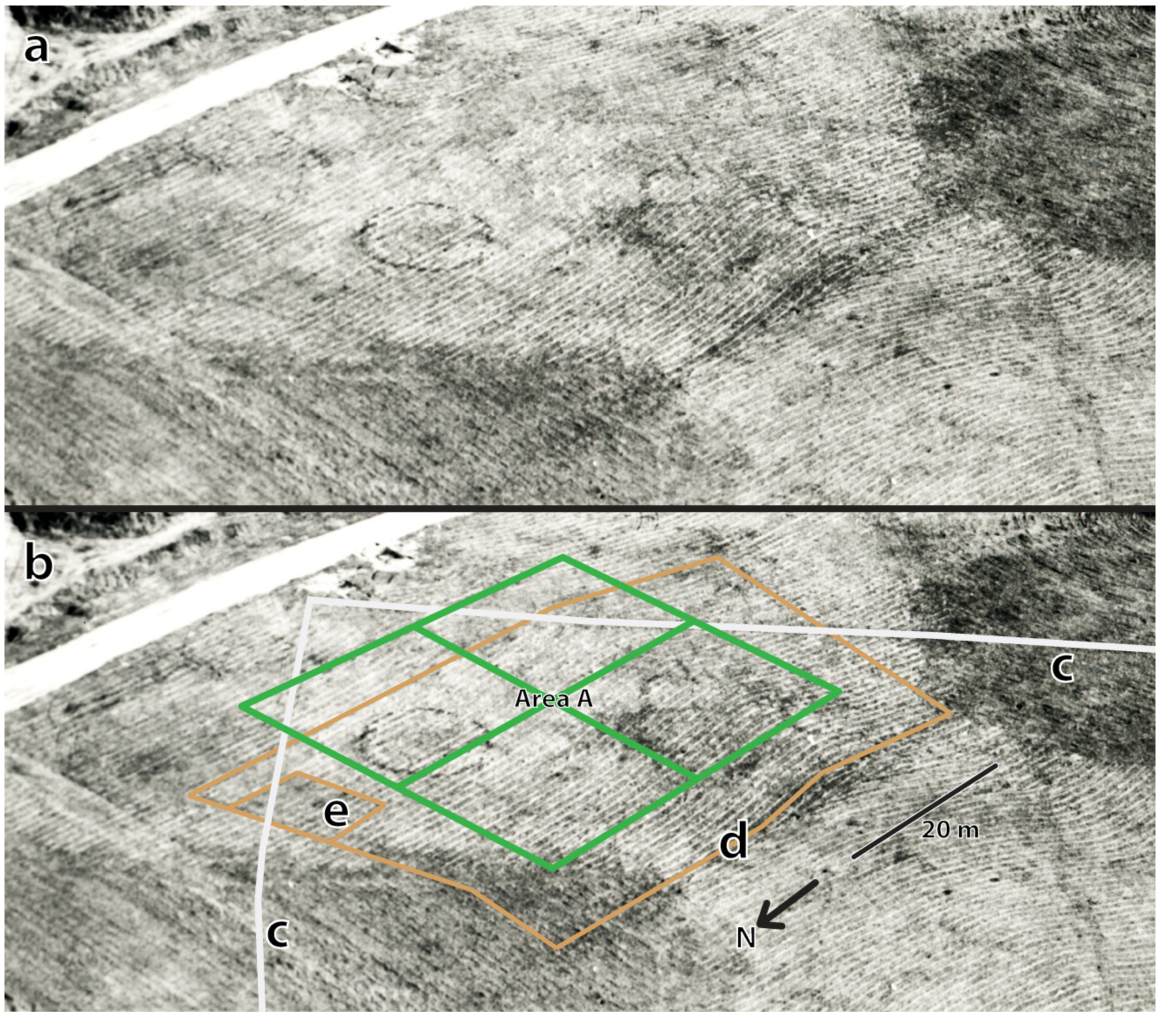

Figure 6.28 – Other anomalies in the aerial photograph: a, aerial photograph; b, aerial photograph with anomalies and Area A marked; c, linear anomaly of double lines; d, large rectangular anomaly about 55 x 40 m in size; e, small rectangular anomaly connected to d.

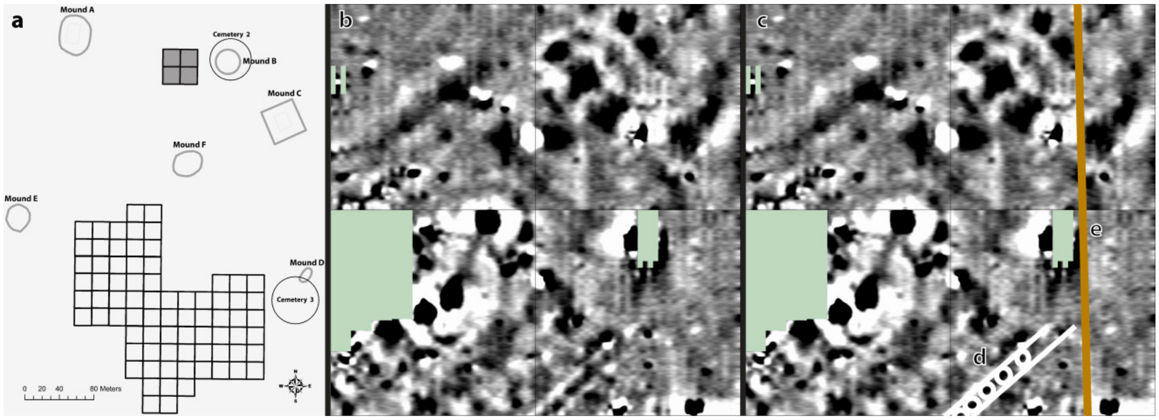

Figure 6.29 – Area A gradiometry with other anomalies: a, position on site; b, gradiometry results; c, gradiometry with other anomalies marked; d, a parallel set of lines about one meter apart characterized by low magnetism; e, a slight line of low magnetism. Areas of increased magnetism are darker and areas of decreased magnetism are lighter. Values are clipped to $\pm$ 1 nT.

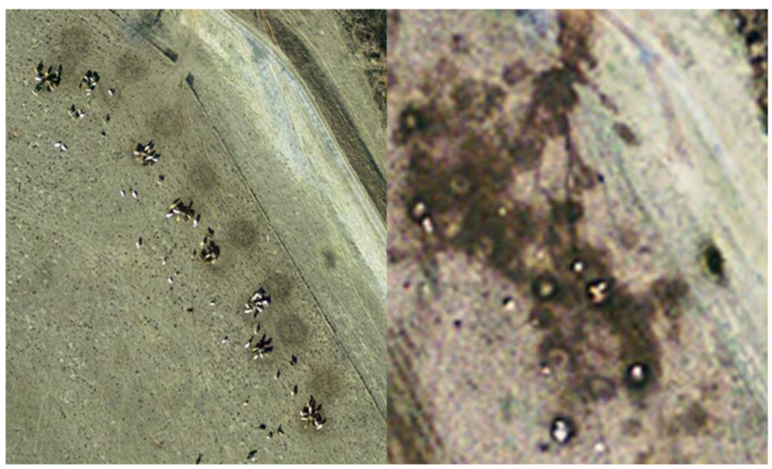

Figure 6.30 – Cattle feeding circles seen in recent aerial photography at Crenshaw. Cattle are shown eating in a circle and disturbing vegetation.

One linear anomaly seen in multiple technologies consists of a set of parallel straight lines and a perpendicular set of parallel straight lines (Figure 6.28:c). The anomaly is visible due to the increased vibrancy of vegetation along the outer edges with slightly decreased vibrancy between the parallel lines. The lines which lead northwest curve in a westerly direction and end up near Mound A. Where they intersect, they meet with the road. It appeared in the gradiometry as a parallel set of lines about one meter apart characterized by low magnetism (Figure 6.29:d). Between the parallel lines, small areas of high magnetism dot the anomaly at one meter intervals. The anomaly is visible in the GPR and runs the full length of the grid (Figure 6.31:d). The northern portion of the anomaly appeared on the northeastern edge of the resistance (Figure 6.32:d). It is represented by an area of increased resistance. This anomaly is likely a set of wheel tracks. Wheel tracks often create double line patterns in GPR, double line patterns of decreased magnetism in gradiometry, and areas of increased resistance. The linear patterns of decreased magnetism are due to the topsoil being removed by the wheels and deposited in the center or on the outer edges of the tracks. This also explains the areas of increased magnetism in the middle of the double lines. The earth along the double lines would likely have been compacted from the weight of the vehicle causing GPR to detect the anomaly and possibly resulting in an area of increased resistance. It appears to have a right angle, but it is likely that it is an artifact of vehicles entering or exiting the road near the same point going in different directions.

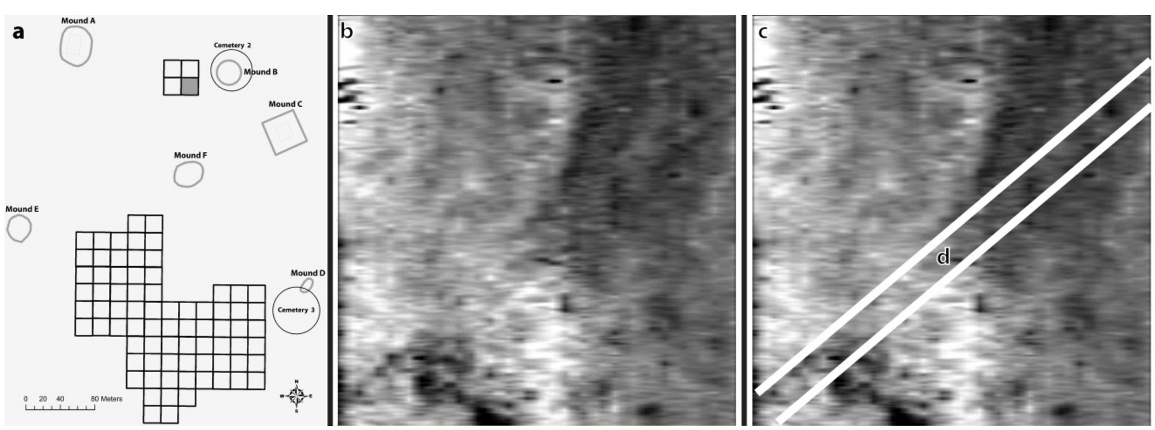

Figure 6.31 - Area A GPR with linear anomaly: a, position on site; b, GPR slice 25 cm deep and 1 cm thick; c, GPR slice with the linear anomaly marked; d, a parallel set of lines about one meter apart.

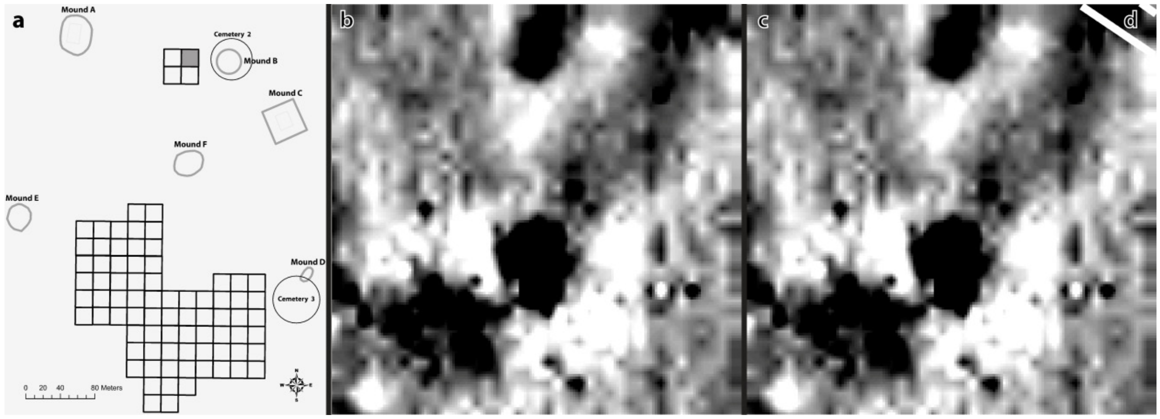

Figure 6.32 – Area A Resistance with other anomalies: a, position on site; b, resistance results; c, resistance with other anomalies marked; d, an area of high resistance values appears in the corner where the anomaly from the aerial photo (Figure 6.28:c) intersects the study area.

Two other examples of probable wheel tracks include two anomalies in the GPR (Figure 6.33:d-e). One anomaly is a set of parallel lines that form a semicircle (Figure 6.33:d). A second linear anomaly has similar properties (Figure 6.33:e). The hay balers that collected hay in the grids just before data collection probably created these wheel tracks. These kinds of anomalies stress the need for caution when interpreting geophysical data as the patterns created by the hay balers could easily have been misinterpreted due to their semi-circular appearance.

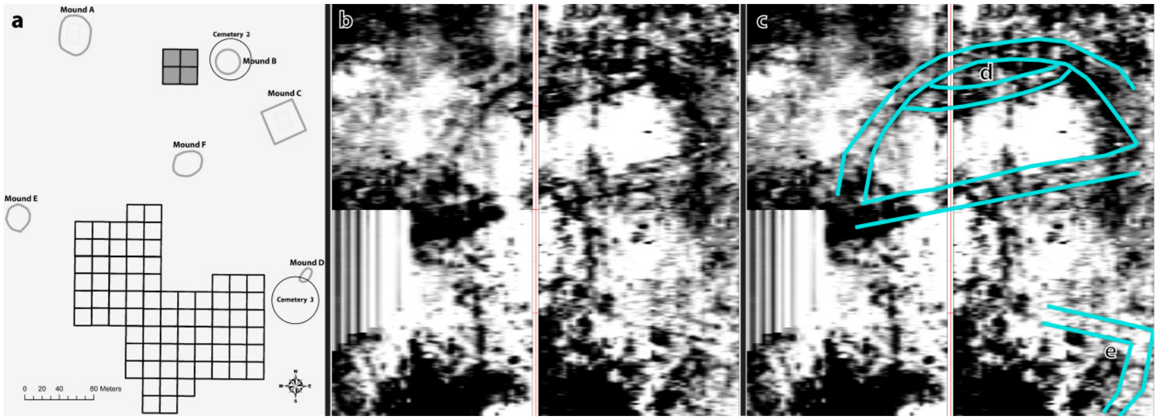

Figure 6.33 – Area A GPR with other anomalies: a, position on site; b, GPR slice 29 cm deep and 1 cm thick; c, GPR slice with other anomalies marked; d, a parallel set of lines about one meter apart forming a semicircle, probably due to wheel tracks; e, another set of parallel lines, probably due to wheel tracks.

A large rectangular anomaly measuring about 55 m north to south and 40 m east to west appeared in the aerial photograph (Figure 6.28:d). The identification of this anomaly came from the more obvious areas on the east side, but the other areas became apparent when the aerial photograph was brightened significantly to enhance the dark portions of the photograph. The anomaly is largely aligned with the mow marks, but has strong corners that make the anomaly easier to see. The anomaly is visible in gradiometry as a slight line of decreased magnetism (Figure 6.28:d). Just below the surface the anomaly was shown as a linear area of alternating reflections (Figure 6.34). There is also a very obvious rectangular anomaly (Figure 6.28:e) aligned with the large rectangular anomaly on the north side, but it was outside of Area A. These anomalies were probably created by historic land owners. They may be a set of fences that form a pattern commonly used in historic times (Moir and Jurney 1987:Figure 15-2). The partitioning of space within a large fence was common practice around 1905 and included small fenced in areas along the edges of the larger fence (Moir and Jurney 1987:241). This interpretation would be consistent with the information presented in Chapter 3, suggesting that the area was used as pasture during historic times. However, it is possible that this anomaly is simply an artifact of the mowing marks. Further geophysical work outside of Area A could identify if ground-based geophysics can detect other parts of the possible fence.

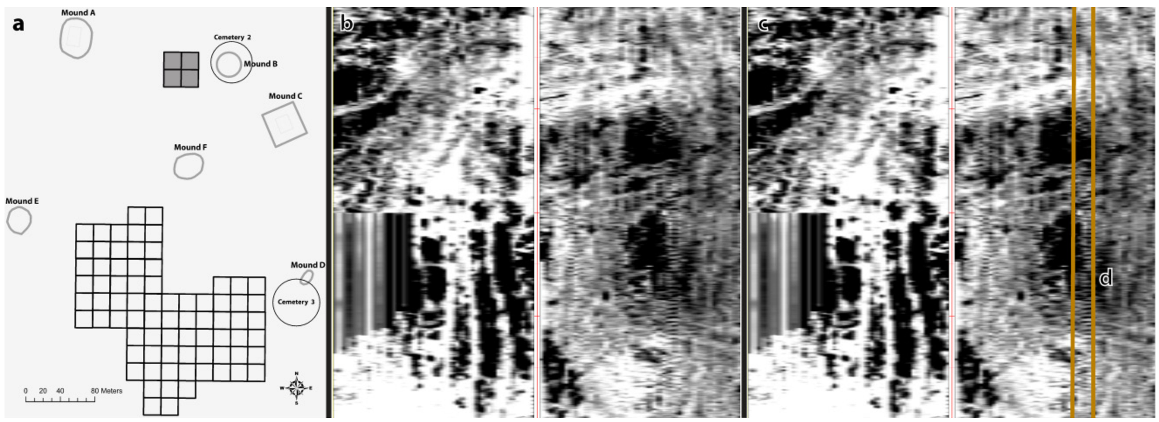

Figure 6.34 – Area A GPR with another anomaly: a, position on site; b, GPR slice 21 cm deep and 1 cm thick; c, GPR slice with another anomaly marked; d, linear anomaly consisting of alternating reflections.

Area B

One linear pattern of small areas of increased magnetism may be indicative of a cemetery (Figure 6.35). These small areas of increased magnetism that comprise the linear pattern are consistent in size and shape with individual burial pits. This possible cemetery area appears to be approximately 30 m long. Another possible cemetery with little linear patterning is apparent in the southern part of Area B (Figure 6.36). Several small areas of increased magnetism exist here, some with areas of decreased magnetism surrounding them. These areas of decreased magnetism may be the result of a halo effect.

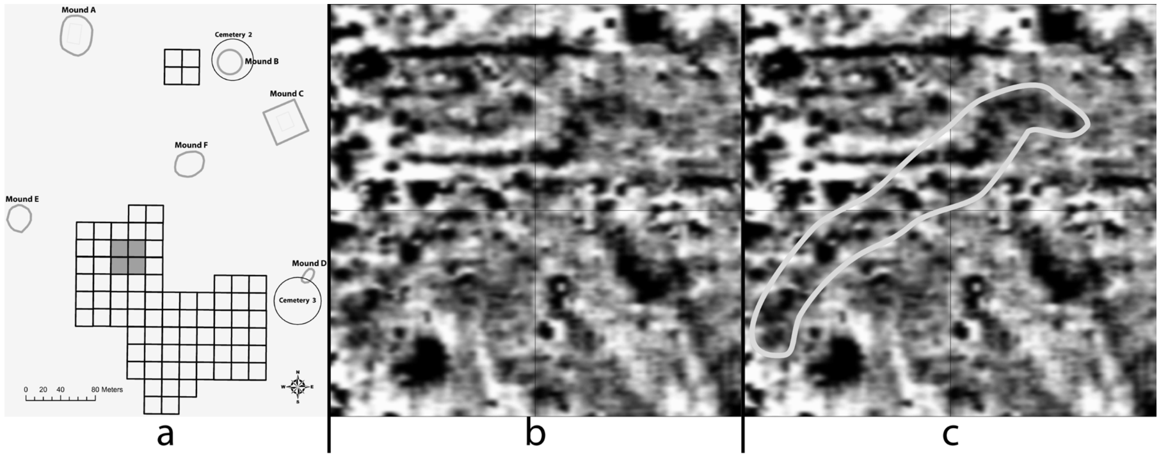

Figure 6.35 – Area B possible cemetery with linear orientation: a, position on site; b, gradiometry results; c, gradiometry with possible cemetery extent overlain. Areas of increased magnetism are darker and areas of decreased magnetism are lighter. Values are clipped to ± .5 nT.

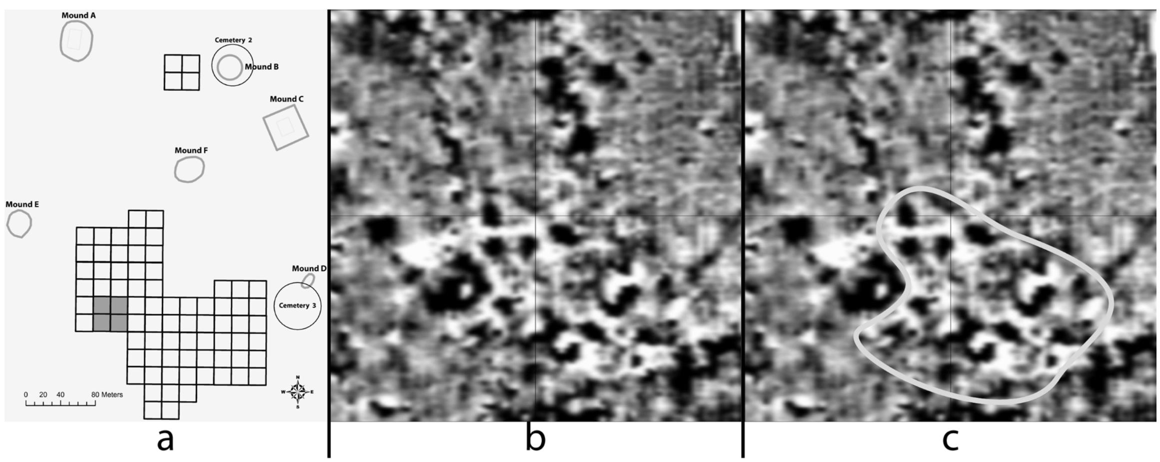

Figure 6.36 – Area B possible cemetery: a, position on site; b, gradiometry results; c, gradiometry with possible cemetery extent overlain. Areas of increased magnetism are darker and areas of decreased magnetism are lighter. Values are clipped to ± .5 nT.

There are also many large areas of increased magnetism throughout Area B that may indicate the presence of structural remains, but the surrounding areas do not have significant circular or rectangular patterns to support that interpretation. Other possible interpretations for these anomalies include large burial pits, refuse pits, or natural low spots that may have been filled with midden.

Area C

Some linear anomalies in the gradiometry are likely due to gullies filled with midden, represented by linear patterns of increased magnetism (Figure 6.14:m). These areas often coincided with areas of low resistance (Figure 6.15:e). As water drains from the landscape, it creates natural lows that, during times of flood, can be filled in with magnetically enriched top soil and eroded midden. Theses filled natural lows are directed downward in the topography so that linear patterns of high magnetism lead from areas with high topography to areas with low topography. This is evident in the gradiometry as these linear patterns are seen, beginning in the higher elevated northeastern part of Area C, and running to the lower elevated southwestern part. The conductivity detected two small areas of increased conductivity just northwest of the West Skull Area that may be related to the drainage areas, but their size and shape suggests they could be burial pits (Figure 6.16:d).

A straight linear anomaly oriented north-northeast to south-southwest, approximately 60 x 5 m in length and width, has been identified in the northeast part of Area C (Figure 6.14:l). It may be an old drainage ditch, as the linear anomalies which are likely due to drainage seem to originate from this anomaly and terminate at a slough that connects with an old river channel. It is possible that this anomaly represents a causeway that points towards the antler temple. The area around the antler temple appears to have been eroded, and this may explain why the linear anomaly stops north of the temple. However, there is not sufficient evidence to support this interpretation as the anomaly does not point to either of the estimated locations of Mound C or Mound D, but rather points between the two mounds, suggesting the possibility of it being a road or pathway; no historic roads or pathways have been recorded in this area, however. Surveying the known causeways at the Crenshaw site with the gradiometer will most likely produce a signature that could be compared to the signature created by this anomaly.

Discussion

Archaeogeophysical survey investigations have identified over 100 possible Fourche Maline or Caddo structures, 50 of which have strong geophysical patterns, in a 3.2 hectare area at the Crenshaw site. The large number and arrangement of possible structures, especially in Area B, suggest that a village existed at the site. While a specific cultural affiliation cannot be assigned to these possible structures without extensive excavations, this does explain the large deposits of midden found at the site.

The topographically higher portions of Area B contain most of the possible structures. Area A is also on high ground and, considering its small size, the density of possible structures is impressive. This suggests that other high topographic areas could contain many prehistoric structures. However, even the topographically low Area C contained many possible structures when multiple geophysical technologies were applied across the area. This point is important because Area B was only surveyed with gradiometry, and even more possible structures may be detected in this area if and when another survey with other geophysical technologies can be conducted there.

There is only one Caddo or Fourche Maline site that can be compared to the number and pattern of possible structures revealed in Area B at Crenshaw. In Northeast Texas, the Oak Hill Village site (41RK214) excavations defined an oval arrangement of

Middle Caddo period houses, over an approximately 100 x 60 m area, around a plaza (Figure 6.37). The houses were also often rebuilt over each other in the same area. One side of this oval habitation area was also more densely covered with structures. The few burials occurred on the outer edge of the plaza (Perttula and Rogers 2007), which is notable given that both of the possible cemeteries detected at Crenshaw in the geophysical investigations lie on the outer edges of the possible plaza in Area B.

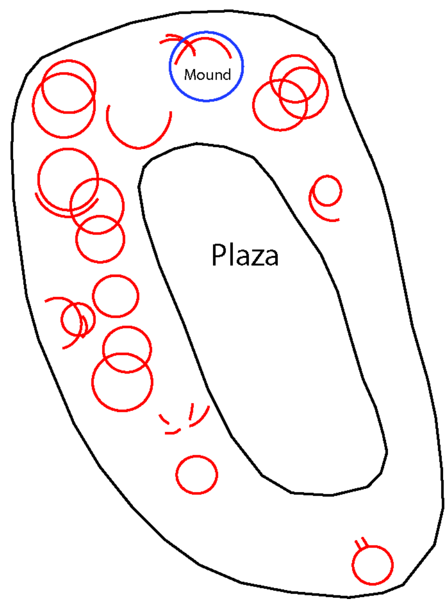

Figure 6.37 – Caddo structures dating between A.D. 1250 and 1350/1375 at the Oak Hill Village Site. They are arranged in an approximately 100 x 60 m oval around a plaza (after Perttula and Rodgers 2007:Figure 10).

Some of the possible structures identified in the geophysical investigations at Crenshaw have similar patterns to the partially excavated and possible rectangular Fourche Maline structure found in the eastern portion of Area C (Figure 6.14:j). These rectangular anomalies have large areas of increased magnetism surrounded by circular or rectangular areas of decreased magnetism. With there being both Fourche Maline and Caddo occupations at Crenshaw, and no available archaeological evidence to suggest a particular cultural affiliation for these possible structures, it is not yet possible to determine who made these possible structures. However, given the large area of coverage and the small amount of post-A.D. 1200 Caddo deposits at the site, the large majority of these possible structures likely belong to occupations that date from ca. A.D. 700 to A.D. 1200.

The three possible structures with extended entranceways may be Caddo structures since extended entranceway structures are a known Caddo architectural feature (Perttula 2009). However, so few Fourche Maline structures have been excavated that it is impossible to rule out a Fourche Maline cultural affiliation for this kind of structure at Crenshaw. Two of the three possible structures with extended entranceways were rectangular while one was circular in shape; however, this diverges from the known ratio of rectangular to circular structures with extended entranceways in the southern Caddo area: only 13% of known Caddo structures with extended entranceways in the southern Caddo area are rectangular while 87% are circular (Perttula 2009:Table 5).

The signatures produced by gradiometry were slightly different in Areas A-C. The structural anomalies in Area B more closely resembled those from Area C than they did anomalies in Area A. In Area C, the possible rectangular Fourche Maline structure with a large interior pit created a signature that was replicated in several anomalies in Area B. Since some of the anomalies may represent Caddo structures and the partially excavated rectangular anomaly in Area C is a possible Fourche Maline structure, there may be at least two different occupations represented in the three areas.

Overall, the archaeogeophysical survey of the site proved to be extremely productive. These results encourage the use of these techniques on other parts of the site.

The aerial photography also proved useful by directing the survey to a location where anomalies were likely to be found. It also provided further support for interpreting circular anomalies found in ground-based archaeogeophysics. While the GPR was variably productive, gradiometry was productive in each area; however, large pieces of metal distorted the magnetic data in some of the gradiometry grid collection areas. Resistance was able to detect anomalies not seen in the gradiometry data.

Chapter 7: Conclusions

Research Questions

The archaeogeophysical survey of the Crenshaw site was conducted to evaluate the Teran-Soule model as a means of interpreting and explaining Caddo settlement patterning. This model suggests that a late to historic Caddo mound center should not have significant evidence of habitation in the off-mound areas of the site. This study used archaeogeophysical techniques in the off-mound areas of the site to attempt to find possible structures to test the model. Since Crenshaw is a Fourche Maline and Caddo site, the discovery of structures with archaeogeophysical techniques requires independent evidence to support assignments of cultural affiliation to the anomalies. With this evidence, the discovery of structures at the site can be used to answer the following research questions:

1. With the understanding that Crenshaw is a hypothesized Fourche Maline to Caddo transition site, does Crenshaw have any features detectable by archaeogeophysical techniques that disconfirm the hypothesis that the site is a vacant ceremonial center? What does this evidence suggest in regard to the Teran-Soule model for Caddo settlement patterning?
2. What is the overall spatial distribution of features detected via archaeogeophysical prospecting? Is there any evidence to suggest multiple occupations (e.g., Fourche Maline, Caddo) through time? Is there any spatial differentiation suggesting the possibility of separating discrete occupational components?

Conclusions

The discovery of over 100 possible structures in the 3.2 hectare study area suggests that Crenshaw was not literally vacant. However, in order to truly test the vacant mound center hypothesis as proposed by Schambach (1982a:120-122), a cultural affiliation for many of these possible structures must be determined through groundtruthing and their associated material must indicate that they were used for domestic purposes. The large numbers of possible structures at Crenshaw, combined with the suggestion that many were contemporaneous, including a possible 90 x 85 m oval area of possible structures, indicate that a village existed at the site. Since the site has long been thought of as a Fourche Maline village site due to the large deposits of Fourche Maline midden, this is not unexpected, but some possible structures have properties that suggest they may belong to a later Caddo occupation.

The properties of four possible structures provide support for the identification of Caddo architectural patterns in the archaeogeophysical data. This includes two possible circular structures in Area A that are approximately 50 m west of the estimated center of Mound B, and the possible structures with extended entranceways in Area B and C. This suggests that the Caddo were using off-mound areas at Crenshaw for more than just burials and an antler temple. If the possible structures are associated with a Caddo occupation, they may be special use structures, which would be consistent with the discovery of the antler temple, the Teran-Soule model, and the Caddo use of extended entranceway structures (Perttula 2009). Therefore, while the data provides ample possibilities for testing the Teran-Soule model and the vacant mound center hypothesis through excavations, it does not conflict with them. However, the large numbers of possible structures found with unknown cultural affiliation suggest that many more Caddo structures may be located in the study area, but will require groundtruthing to determine their cultural affiliation. While this model has been questioned at other Middle to Late Caddo mound sites in southwestern Arkansas (Lockhart 2007; McKinnon 2008), those archaeogeophysical studies have not found sufficient evidence of large numbers of non-special use structures that may have been contemporaneously occupied. Further study of these sites may continue to reveal that off-mound portions of Caddo sites in southwestern Arkansas contain possible domestic structures.

The discovery of four possible compound fences, measuring between 25 and 48 m in diameter, in the study area provides more support for the existence of areas with circular enclosures surrounding small farmsteads, as shown in the Teran map, although it is not clear if there are farmsteads or farmstead compounds at the Crenshaw site. These possible compounds are also located in the central portions of the mound center, which contradicts the settlement patterning seen on the Teran map. The question remains if these possible compounds are related to structures used for habitation or to structures used for special purposes.

The overall spatial distribution of features in the archaeogeophysical results show that structures are more likely to be found in higher elevated areas of the site, but that lower areas of the site may also contain structures. At least two possible structures west of Mound B are likely Caddo structures, indicating at least one occupation of the site. The discovery of a possible Fourche Maline structure in a line of possible structures suggests that the Fourche Maline peoples were using the area near Mound D, which is also supported by the presence of a Fourche Maline midden in that area (Schambach 1982a:150). The large numbers of possible structures in Area B are of unknown cultural affiliation, but their signatures are more comparable to the possible Fourche Maline structure near Mound D than they are to the possible Caddo structures near Mound B. Therefore, at least two separate occupations are represented in the study area with a likely Caddo occupation west of Mound B, a Fourche Maline occupation west of Mound D, and more possible occupations south of Mound E and Mound F.

Possible Improvements

Several aspects of this study could have been executed differently in a way that would have reduced the complexity and increased the quality of the information gathered. The first change would have been to reassign the permanent datum located at N190 W65 to N1190 E935 to make N0 E0 become N1000 E1000. This would have moved the site into a single quadrant. Besides making the presentation more readable, it would have made the laying out of the grids much easier. Reading from the total station in negative numbers made it difficult to adjust the position of the prism in the right direction, causing endless frustration.

Many grids of gradiometry were lost that severely hampered the ability to interpret the possible oval of structures and the possible second row of structures to the west. The download method for any instrument should be verified before actual data needs to be downloaded to a particular computer to ensure that no issues will arise after data collection. Additionally, it is always a good idea to download the data immediately after the collection to minimize the possibility of data getting deleted from the instrument before it can be downloaded. The data should then be backed up in more than one location to prevent data loss.

The gradiometry was collected at 1.4 m/s with as much as eight measurements per meter. This may have caused some staggering issues that would have been reduced if a slightly slower pace was used. The initial use of one meter transect spacing allowed for the identification of possible structures, but the quality of information provided by .5 m transect spacing completely overrode the small amount of time gained by collecting lower resolution data in this case. The accuracy of the gradiometry was enhanced by using guiding ropes every two meters. However, more data could have been collected with much less effort and people had plastic pin flags been used as guides instead. This relies on the operator's ability to maintain a straight line and pace accurately. Since more than half the man hours in the field were used setting up grids with ropes, using the pin flag method would have allowed for a larger area to be covered with gradiometry with fewer resources. An EM could similarly be used with such a system given the operator is capable of pacing accurately and keeping a straight line. GPR with a wheel marker is best suited for such a system as it only relies on the operator's ability to keep a straight line. However, grids where resistance will be taken will still need ropes to guide the placement of the probes along transects.

GPR and resistance datasets from Area C were much more productive than the datasets from Area A. The major difference between these sections was the conditions of the soil at the time data was collected. When resistance was taken of Area C, it had just rained for several days and the soil was saturated with water. When Area A was surveyed, the site was experiencing a strong drought. The dry weather likely hampered resistance. In the future, it would benefit a study to conduct a survey with resistance during a wet time of the year to ensure that anomalies can produce good contrast with the surrounding soil. In Area A, GPR was not very productive, possibly due to differences in soil properties. GPR should not be used over hay. Instead, a survey should wait until all hay is cleared from the area before any data is collected. Even different heights of grass can cause large disturbances in the data. Since the GPR data from Area C was so productive, more in this section might have been acquired. However, the GPR was only used in the section on the last day of the survey, so more data could not be collected. To prevent this scenario, different instruments should be used at the beginning of a survey to test their capabilities, rather than waiting until the end.

Magnetic susceptibility in Area C was useful, but would have been more useful if a higher resolution of .5 by .5 m was consistently taken over a larger area. The best use for this technology may be to use it over known anomalies from other technologies or to use it in areas where metal scatter distorts the gradiometry.

Future Work

Groundtruthing of many anomalies could define and validate the information presented in this study. The excavation of the possible Caddo structures in Area A could validate that the structures exist and the interpretation that the Caddo created them.

A small test excavation across the 48 m compound fence in Area C could confirm its presence. Excavation of the rectangular anomaly with an extended entranceway in Area C could provide an explanation for who built the compound fence in the area. This could determine if compounds exist and whether it was the Caddo or the Fourche Maline who were building compounds on the site. Analyzing artifacts already excavated or from test units might also contribute to our understanding of some possible structures.

A collection of small test units or coring samples could be used to determine the cultural affiliation or time period of the possible structures in Area B by retrieving artifacts or carbon samples from interior pits or hearths. Defining a general time period for these possible structures would determine if it is a Caddo or Fourche Maline village and could provide better dates for site occupation.

Excavating a possible structure associated with a Fourche Maline occupation would result in the first undisputed documented excavation of an entire Fourche Maline house used for habitation, according to Schambach (2001). Several anomalies are similar to the possible rectangular Fourche Maline structure in Area C and may be good candidates for testing. A cultural affiliation could be determined by coring before excavation to insure that the structure being excavated is a Fourche Maline structure.

An archaeogeophysical survey of the Mound A, Mound E, and Mound F could be useful to provide some clue as to what they contain and when they were constructed. A survey of Mound F might reveal the total extent of the large burial beneath the mound. A survey of Mound A and Mound E might finally reveal some aspect of what they contain, if anything at all. Also, a survey of the causeway between Mound A and Mound E could provide an anomaly that could be compared to anomalies discovered elsewhere on the site so that if there are other causeways present, their signatures can be correctly interpreted.

The site would benefit from a full scale gradiometry survey to determine its extent and to determine if the concentrations of possible structures found in Area B are common elsewhere on the site. This could reveal how different portions of the site might have been used by different occupations. It could also determine if other types of features are present, such as causeways, pathways, or cemeteries.

A study of Caddo and Fourche Maline sites in the vicinity of Crenshaw could help reveal more information about their settlement patterns. Some could benefit from an archaeogeophysical survey. One Fourche Maline or Caddo mound (3HE12) still exists about 3 km to the east and another mound (3HE17) exists about 3 km to the north of Crenshaw. An archaeogeophysical survey of these sites might result in signatures that could be compared to anomalies at Crenshaw. Such a comparison would be a useful test to better define what kinds of anomalies are typical of Fourche Maline occupations. It could also be a good test case to see if structures containing large pits, like the ones at the Bellevue mound and Cicero Young mound, are located beneath these mounds.

References Cited

Arkansas Archeological Survey
2009 Site File Extensions: 3MI6. Notes on file, Arkansas Archeological Survey, Fayetteville.

Arkansas Commissioner of State Lands Office
2000 Original Gerneral Land Office Survey Notes and Plats for the State of Arkansas 1815-present. CD-ROM.

Arkansas Highway and Traffic Department
2009 Historic Highway Maps - Miller County, Arkansas. Electronic document, ftp://ftp.geostor.arkansas.gov/geostor_raster_02/AHTD_map_series/historic/, accessed on July 30, 2009.

Aspinall, A. and J. T. Lynam
1970 An Induced Polarization Instrument for the Detection of Near Surface Features. *Prospezioni Archeologiche* 5:67-75.

Barnes, James E.
1992 Bioarcheology at the Plaza of the Skulls, the Crenshaw Site: A Preliminary Report. Presented at the Arkansas Archeological Society Meeting, Camden , Arkansas. Manuscript on file, Arkansas Archeological Survey, Fayetteville.

Bevan, B. W.
1998 *Geophysical Exploration for Archaeology: An Introduction to Geophysical Exploration*. Special Report No. 1. U.S. Department of the Interior, National Park Service, Midwest Archeological Center, Lincoln, Nebraska.

Bowman, I.
1911 *Forest Physiography: Physiography of the United States and Principles of Soils in Relation to Forestry*. John Wiley and Sons, London.

Braun, E. Lucy
1950 *Deciduous Forests of Eastern North America*. The Blakiston Company. Philadelphia.

Bruseth, J. E.
1998 The Development of Caddoan Polities Along the Middle Red River Valley of Eastern Texas and Oklahoma. In *The Native Culture History of the Caddo: Their Place in Southeastern Archeology and Ethnography*, edited by Timothy K. Perttula and J. E. Bruseth, pp. 47-68. Texas Archeological Research Laboratory, Studies in Archeology 30. The University of Texas, Austin.

Clark, Anthony
2000 [1990] *Seeing Beneath the Soil: Prospecting Methods in Archaeology*. Routledge, London. B. T. Batsford, London.

Conyers, Lawrence B.
2004 *Ground-Penetrating Radar for Archaeology*. AltaMira Press, Walnut Creek, California.

Creel, Darrell, Dale Hudler, Samuel Wilson, Clay Schultz and Chet Walker
2005 *A Magnetometer Survey of Caddoan Mounds State Historic Site*. Texas Archeological Research Laboratory. Technical Report 51. The University of Texas, Austin.

Creel, Darrell, Dale Hudler, Samuel Wison, Chester Walker, and T. Clay Schultz
2008 Geophysical Survey of the Mound B Area at the George C. Davis Site. *Bulletin of the Texas Archeological Society* 79:177-190.

Dickinson, S. D.
1936 Ceramic Relationships of the Pre-Caddo Pottery from the Crenshaw Site. *Texas Archeological and Paleontological Society Bulletin* 8:56-69.

Durham, James H. and Michael K. Davis
1975 Report on Burials Found at Crenshaw Mound C, Miller County, Arkansas. *Bulletin of the Oklahoma Anthropological Society* 23:1-90.

Durham, James H. and Glen L. Kizzia
1964 A Deep Burial in Crenshaw Mound "C". Miller County, Arkansas. *Central States Archeological Journal* 11(2):44-67.

Early, Ann M.
1998 Features. In *Standridge: Caddoan Settlement in a Mountain Environment*, edited by Ann M. Early, pp. 45-60. Arkansas Archeological Research Series 29, Fayetteville.

2000 The Caddos of the Trans-Mississippi South. In *Indians of the Greater Southeast*, edited by B. G. McEwan, pp. 122-141. University Press of Florida, Gainesville.

Fassbinder, Jörg W., Helge Stanjek, and Hojatollah Vali
1990 Occurrence of Magnetic Bacteria in the Soil. *Nature* 343(6254):161-163.

Fenneman, Nevin M.
1938 *Physiography of Eastern United States*. McGraw-Hill, New York and London.

Fulton, Robert L. and Clarence H. Webb
1953 *The Bellevue Mound: A Pre-Caddoan Site in Bossier Parish, Louisiana*. Reprinted from Volume 24, Bulletin of Texas Archeological Society, Austin.

Gaffney, Chris F. and John A. Gater
2003 *Revealing the Buried Past: Geophysics for Archaeologists*. Tempus Publishing Ltd. Stroud, Gloucestershire.

Giardino, Marco and Bryan S. Haley
2006 Airborne Remote Sensing and Geospatial Analysis. In *Remote Sensing in Archaeology*, edited by Jay K. Johnson, pp. 47-77. The University of Alabama Press, Tuscaloosa.

Good, Carolyn E.
1982 Analysis of Structures, Burials, and Other Cultural Features. In *The Deshazo Site Nacogdoches County, Texas Volume 1: The Site, Its Setting, Investigation, Cultural Features, Artifacts of Non-Native Manufacture, and Subsistence Remains*, edited by Dee Ann Story, pp. 51-112. Texas Antiquities Permit Series No 7, Austin.

Guccione, Margaret J.
2008 Impact of the Alluvial Style on the Geoarcheology of Stream Valleys. *Geomorphology* 101(1-2):378-401.

Guccione, Margaret J., Michael C. Sierzchula, Robert H. Lafferty III, and David Kelley
1998 Site Preservation along an Active Meandering Avulsing River: The Red River, Arkansas. *Geoarchaeology* 13(5):475-500.

Head, Lawrence H. Jr.
1990 The Crenshaw Site, 3MI6. *Field Notes: Newsletter of the Arkansas Archeological Society* 237:3-5.

Head, Lawrence H. Jr. and Judy Head
2009 Email correspondence: 03/01/2009-03/02/2009. Unpublished 3MI6 site file extension, Arkansas Archeological Survey, Fayetteville.

Hemmings, E. Thomas
1982 Vertebrate Fossils from Recent Red River Point Bar and Channel Bar Deposits in the Great Bend Region. In *Contributions to the Archeology of the Great Bend Region*, edited by Frank F. Schambach and Frank Rackerby, pp. 30-38. Arkansas Archeological Survey Research Series No 22, Fayetteville.

Hoffman, Michael P.
1970 Archaeological and Historical Assessment of the Red River Basin in Arkansas. In *Archeological and Historical Resources of the Red River Basin*, edited by Hester A. Davis, pp. 135-194. Arkansas Archeological Survey Research Series 1, Fayetteville.

1994 Summary of the Great Bend Region Prehistory. In *Part I and II: A Cultural Resources Assessment of Proposed Interstate 71 Corridors Between Texarkana and Louisiana, Miller County, Arkansas*, edited by Carol S. Spears, Lawrence G. Santeford, Michael P. Hoffman, and Anne L. Moerbe, pp. 22-41. Revised March 1994. West Fork, Arkansas: Spears Professional Environmental and Archeological Research Service, Inc.

Jackson, H. Edwin, Susan L. Scott, and Frank Schambach
2009 At the House of the Priest: Faunal Remains from the Crenshaw Site (3MI6), Southwestern Arkansas. In *The Archaeology of the Caddo*, edited by Timothy K. Perttula and Chester P. Walker. Volume under review, University of Nebraska Press, Lincoln.

Kvamme, Kenneth L.
2003 Geophysical Surveys as Landscape Archaeology. *American Antiquity* 68(3):435-458.

2006 Magnetometry: Nature's Gift to Archaeology. In *Remote Sensing in Archaeology*, edited by Jay K. Johnson, pp. 205-233. The University of Alabama Press, Tuscaloosa.

Lemley, Harry J.
1936 Discoveries Indicating a Pre-Caddo Culture on Red River in Arkansas. *Texas Archeological and Paleontological Society Bulletin* 8:25-55.

Lindford, N. T. and M. G. Canti
2001 Geophysical Evidence for Fires in Antiquity: Preliminary Results from an Experimental Study. *Archaeological Prospection* 8(4):211-226.

Lockhart, Jami J.
2007 *Prehistoric Caddo of Arkansas: A Multiscalar Examination of Past Cultural Landscapes*. Ph.D. dissertation, Department of Geosciences, University of Arkansas, Fayetteville.

Miroir, M. Pete
1942 The Crenshaw Place. Unpublished notes from Crenshaw Site (3MI6) 1940-1942 excavations. Manuscript on file, University of Arkansas Museum, Fayetteville.

McKinnon, Duncan P.
2008 *An Archaeogeophysical Analysis of Central Caddo Settlement Patterning at Battle Mound (3LA1)*. M.A. Thesis, Department of Anthropology, University of Arkansas, Fayetteville.

McCall, E.
1988 The Attack on the Great Raft. *American Heritage of Invention and Technology* 3(3):10-16.

Moir, Randall W. and David H. Jurney
1987 Richland Creek Farmsteads: Summary and Conclusions. In *Historic Buildings, Material Culture, and People of the Prairie Margin*, edited by David H. Jurney and Randall W. Moir, pp. 239-245. Richland Creek Technical Series V. Archaeology Research Program, Institute for the Study of Earth and Man, Dallas, Texas.

Moore, Clarence B.
1912 Some Aboriginal Sites on the Red River. *Journal of Academy of Natural Sciences of Philadelphia* 14:481-638.

Nassaney, Michael S. and Kendra Pyle
1999 The Adoption of the Bow and Arrow in Eastern North America: A View from Central Arkansas. *American Antiquity* 64(2):243-263.

Newell, H. Perry and Alex D. Krieger
1949 *The George C. Davis Site, Cherokee County, Texas*. Memoirs No. 5. Society for American Archaeology, Menasha, Wisconsin.

Osburn, Tiffany, James Bruseth, and William Pierson
2008 Magnetometer Investigations at the George C. Davis site, a Prehistoric Caddo Village. *Bulletin of the Texas Archeological Society* 79:191-200.

Pearson, Charles E.
1982 Geomorphology and Prehistoric Settlement Patterns in the Great Bend Region. In *Contributions to the Archeology of the Great Bend Region*, edited by Frank F. Schambach and Frank Rackerby, pp. 12-29. Arkansas Archeological Survey Research Series No 22, Fayetteville.

Perttula, Timothy. K.
1992 *The Caddo Nation*. University of Texas Press, Austin.

1996 Caddoan Area Archaeology Since 1990. *Journal of Archaeological Research* 4(4): 295-348.

2005 1938-1939 WPA Excavations at the Hatchel Site (41BW3) on the Red River in Bowie County, Texas. *Southeastern Archaeology* 24(2):180-198.

2009 Extended Entranceway Structures in the Caddo Archaeological Area. *Southeastern Archaeology* 28(1):27-42.

Perttula, Timothy K. and Robert Rodgers
2007 The Evolution of a Caddo Community in Northeastern Texas: the Oak Hill Village Site (41RK214), Rusk County, Texas. *American Antiquity* 72(1):71-94.

Perttula, Timothy K., Chester P. Walker, and T. Clay Schultz
2008 A Revolution in Caddo Archaeology: The Remote Sensing and Archaeological View from the Hill Farm Site (41BW169) in Bowie County, Texas. *Southeastern Archaeology* 27(1):93-107.

Powell, Mary Lucas
1977 Prehistoric Ritual Skull Burials at the Crenshaw Site (3MI6), Southwest Arkansas. *Bulletin of the Texas Archeological Society* 48:111-118.

Rodgers, Robert and Timothy K. Perttula
2004 The *Oak Hill Village Site (41RK214) Rusk County, Texas*. Document No. 030083. PBS&J, Austin.

Rose, Jerome C., Michael P. Hoffman, Barbara A. Burnet, Anna M. Harmon, and James E. Barnes
1998 Skeletal Biology of the Prehistoric Caddo. In *The Native Culture History of the Caddo: Their Place in Southeastern Archeology and Ethnography*, edited by Timothy K. Perttula and J. E. Bruseth, pp. 113-126. Texas Archeological Research Laboratory, Studies in Archeology 30. The University of Texas, Austin.

Sabo, George III
2009 Archaeomagnetic Dating in Arkansas. *Field Notes: Newsletter of the Arkansas Archeological Society* 348:6-8.

Sammis, Ted and Esteban Herrera
1999 Estimating Water Needs for Pecan Trees. Guide H-636. PH 4-200. Cooperative Extension Service. College of Agriculture and Home Economics, New Mexico State University. Electronic document, http://aces.nmsu.edu/pubs/_h/h-636.pdf, accessed June 8, 2009.

Schambach, Frank
1969 Original unpublished field notes from Crenshaw Site (3MI6) 1969 excavations. Manuscript on file, Arkansas Archeological Survey, Fayetteville.

1971a The Trans-Mississippi South: The Case for a New Natural Area West of the Lower Mississippi Valley and East of the Plains. Presented at the Caddo Conference, 13th Annual Meeting, University of Texas, Austin, March 27. Manuscript on file, Arkansas Archeological Survey, Fayetteville.

1971b Exploratory Excavations in the Midden Areas at the Crenshaw Site, Miller County, Arkansas. Manuscript on file, Arkansas Archeological Survey, Fayetteville.

1982a A Research Design for Continued Investigations of the Caddo V Component at the Cedar Grove Site. In *Contributions to the Archeology of the Great Bend*

Region, edited by Frank F. Schambach and Frank Rackerby, pp. 118-122. Arkansas Archeological Survey Research Series 22, Fayetteville.

1982b An Outline of Fourche Maline Culture in Southwest Arkansas. In *Arkansas Archeology in Review*, edited by N.J. Trubowitz and M. D. Jeter, pp. 132-197. Arkansas Archeological Survey Research Series 15, Fayetteville.

1982c The Archeology of the Great Bend Region in Arkansas. In *Contributions to the Archeology of the Great Bend Region*, edited by Frank F. Schambach and Frank Rackerby, pp. 1-11. Arkansas Archeological Survey Research Series 22, Fayetteville.

1983 Original unpublished field notes from Crenshaw Site (3MI6) 1983 excavations. Manuscript on file, Arkansas Archeological Survey, Fayetteville.

1996 Mounds, Embankments, and Ceremonialism in the Trans-Mississippi South. In *Mounds, Embankments, and Ceremonialism in the Midsouth*, edited by Robert C. Mainfort and Richard Walling, pp. 36-43. Arkansas Archeological Survey Research Series No. 46, Fayetteville.

1997 The Development of the Burial Mound Tradition in the Caddo Area. *Journal of Northeast Texas Archaeology* 9:53-72.

1998 *Pre-Caddoan Cultures in the Trans-Mississippi South: A Beginning Sequence*. Arkansas Archeological Survey Research Series No. 53, Fayetteville.

2001 Fourche Maline and Its Neighbors: Observations on an Important Woodland Period Culture of the Trans-Mississippi South. For 1999. *The Arkansas Archeologist, Bulletin of the Arkansas Archeological Society* 40:21-50.

2002 Fourche Maline: A Woodland Period Culture of the Trans-Mississippi South. In *The Woodland Southeast*, R. C. Mainfort Jr. and D. G. Anderson eds., pp. 90-112. University of Alabama Press, Tuscaloosa & London.

2004 Dr. Harrison and Crenshaw. *Field Notes: Newsletter of the Arkansas Archeological Society* 321:2.

Schambach, Frank, Neal L. Trubowitz, Frank Rackerby, E. Thomas Hemmings, W. Fredrick Limp, and John E. Miller III

1982 Test Excavations at the Cedar Grove Site (3LA97): A Late Caddo Farmstead in the Gread Bend Region, Southwest Arkansas. In *Contributions to the Archeology of the Great Bend Region*, edited by Frank F. Schambach and Frank Rackerby, pp. 90-140. Arkansas Archeological Survey Research Series 22, Fayetteville.

Scott, Susan L. and H. Edwin Jackson
1998 Early Caddo Ritual and Patterns of Animal Use: An Analysis of Faunal Remains from the Crenshaw Site (3MI6), Southwestern Arkansas. *Bulletin of the Arkansas Archeological Society* 37:1-37.

Smith, F. T.
1994 The Red River Caddos: A Historical Overview to 1835. *Bulletin of the Texas Archeological Society* 65:115-127.

Story, Dee Ann
1997 1968-1970 Archeological Investigations at the George C. Davis Site, Cherokee County, Texas. *Bulletin of the Texas Archeological Society* 68:1-103.

1998 The George C. Davis Site: Glimpses into Early Caddoan Symbolism and Ideology. In *The Native Culture History of the Caddo: Their Place in Southeastern Archeology and Ethnography*, edited by Timothy K. Perttula and J. E. Bruseth, pp. 47-68. Texas Archeological Research Laboratory, Studies in Archeology 30. The University of Texas, Austin.

Strickland, Rex W.
1940 Miller County, Arkansas Territory, The Frontier that Men Forgot. *Chronicles of Oklahoma* 40(1):12-34.

Trubitt, Mary Beth
2008 Excavations at Two Caddo Mound Sites in Southwest Arkansas. Presented at the Southeastern Archaeological Conference, 65th Annual Meeting, Charlotte, NC, November 12-15.

Trubowitz, Neal L.
1984 *Cedar Grove: An Interdisciplinary Investigation of a Late Caddo Farmstead in the Red River Valley*. Arkansas Archeological Survey Research Series No. 23, Fayetteville.

University of North Carolina Library
2009 Gilmer Civil War Maps Collection: Map drawn by M. A. Miller in 1864. In Collection: Jeremy Francis Gilmer Papers. Electronic document, http://dc.lib.unc.edu/cdm4/item_viewer.php?CISOROOT=/gilmer&CISOPTR=74, accessed on March 1, 2009.

United States Department of Agriculture
1984 *Soil Survey of Lafayette, Little River, and Miller Counties, Arkansas*. National Cooperative Soil Survey.

United States Engineer Department
1886 Survey of Red River and tributaries, Arkansas and Louisiana. U.S. Engineer Department, New Orleans.

United States Geological Survey
2009 Aerial Photography. Electronic document, http://edcsns17.cr.usgs.gov/EarthExplorer/, accessed on March 1, 2009.

Vehik, S. H.
1994 Cultural Continuity and Discontinuity in the Southern Prairies and Cross Timbers. In *Plains Indians, A.D. 500-1500: The Archaeological Past of Historic Groups*, edited by K. H. Schlesier, pp. 239-263. University of Oklahoma Press, Norman and London.

Walker, Chester and Timothy K. Perttula
2008 Geophysical Investigations on Caddo Sites in East Texas and Surrounding States. *Bulletin of the Texas Archeological Society* 79:159-176.

Webb, Clarence H.
1959 *The Belcher Mound: A Stratified Site in Caddo Parish, Louisiana*. Memoirs No. 16. Society for American Archaeology, Salt Lake City.

Wedel, Mildred M.
1978 *La Harpe's 1719 Post on Red River and Nearby Caddo Settlements*. Bulletin 30. Texas Memorial Museum, Austin.

Weinstein, Richard A., David B. Kelley and Joe W. Saunders
2003 Introduction. In *The Louisiana and Arkansas Expeditions of Clarence Bloomfield Moore; Edited and With an Introduction by Richard Weinstein, David B. Kelley, and Joe W. Saunders*, edited by Richard A. Weinstein, David B. Kelley, and Joe W. Saunders, pp. 1-187. Classics in Southeastern Archaeology, S. Williams, general editor. The University of Alabama Press, Tuscaloosa and London.

Williams, G. Ishmael Jr.
1993 Features and Dating. In *Caddoan Saltmakers in the Ouachita Valley*, edited by Ann M. Early, pp. 37-48. Arkansas Archeological Survey Research Series No 43, Fayetteville.

Wolfman, Daniel
1982 Archaeomagnetic Dating in Arkansas and the Border Areas of Adjacent States. In *Arkansas Archeology in Review*, edited by N.J. Trubowitz and M. D. Jeter, pp. 277-300. Arkansas Archeological Survey Research Series 15, Fayetteville.

Wood, W. Raymond
1962 A Preliminary Report on the 1962 Excavations at the Crenshaw Site – 3MI6. In *Arkansas Archeology 1962*, edited by Charles R. McGimsey III, pp. 1-14. Arkansas Archeological Society, Fayetteville.

1963a *The Poole Site: Components of the Fourche Maline and Mid-Ouachita Foci in Garland County, Arkansas*. Manuscript on file, University of Arkansas Museum, Fayetteville.

1963b The Crenshaw Site: A Coles Creek and Caddoan Mound Group in Miller County, Arkansas. Manuscript on file, University of Arkansas Museum, Fayetteville.

1981 The Poole Site. *The Arkansas Archeologist, Bulletin of the Arkansas Archeological Society* 22:7-65.

Wyckoff, D. G.
1994 The Calf Creek Horizon in the Osage Savannah. *Bulletin of the Oklahoma Anthropological Society* XL for 1991:9-10.